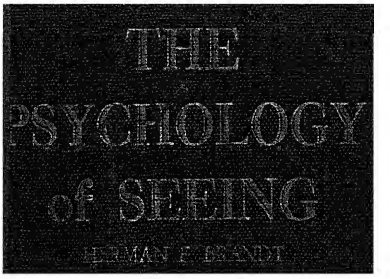
THE
PSYCHOLOGY
of SEEING
HERMAN F. BRANDT

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THE PSYCHOLOGY of SEEING

by

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PREFACE

The writing of this volume has been prompted by the many requests for reprints dealing with findings in the Visual Research Laboratories. Both published and unpublished research studies have been assembled and an attempt to provide first-hand information has been one of the major objectives in the peparation of this volume.

Since the eye is essential in every walk of life and since it affords the main avenue for the acquisition of information, the writer is hopeful that the illustrations and written expressions may serve four practical ends:

Call attention to ocular Photography as scientific approach to the study of human behavior;

Add new information to the already known principles of the psychology of seeing;

Make available to educators, artists, advertisers, oculists, lighting engineers, and vocational counselors such findings as may be applicable to their respective fields;

Provide an inspiration to all those pursuing the studies of ocular performance and their psychological implications.

Few references to research studies of other scientists working in the same and allied fields have been made. This procedure has been followed simply because the entire compilation is mainly a report of the Visual Research Laboratories and hence not a review of the many major and minor studies dealing with the same subject.

The readers may at times sense a repetition of methods of procedures employed in studies assembled and occasional sweeping statements. The common pattern emerged as a result of an attempt to combine studies published elsewhere, and if over-enthusiasm is manifest it is largely because the writer projected his imagination beyond known facts for the purpose of citing potential fields of investigation.

The reader is therefore expected to accept no more than is born out by factual data, and that in the light of samples selected and statistical treatment employed. The above statements are not a justification for shortcomings but rather an expression of the recognition of the dual problem involevd.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to the authors, editors and publishers for their permission to reprint illustrations and portions of articles by the author originally published in books and periodicals.

American Journal of Optometry, Vol. 19, page 405-425, Fig. 7, 8, 9, 12, 43. 44, 49A, 49B, Tables XIII, XIV, XVI, XVII.

American Journal of Psychology, Vol. 53, April, 1940, page 260-268, Fig. 7, 8, 12, Tables I, II; Vol. 53, October 1940, page 564-574, Fig. 22, 23, 24, 25, Tables V to VIII; Vol. 54, October 1941, page 528-535, Fig. 48, 50, Tables XVI to XXIII; Vol. 55, April 1942, page 230-240, Fig. 26, 28, 29, Table VII.

Illuminating Engineering, May 1944, page 279-289, Fig. 2, 11A, 11B, 19, 21A, 21B.

Proceedings of the Iowa Academy of Science, Vol. 48, 1941, page 367-375, Fig. 58, 50, Tables XVI to XIX; Vol. 49, 1942, page 390-404, Fig. 67, 68, 69, 70, 71, Tables XXV to XXXI; Vol. 50, 1943, page 295-298, Fig. 31, Tables IX, X.

Tide, October 15, 1939, Fig. 2, 3; December 1, 1939, Fig. 15; January 1, 1940, Fig. 11A, 11B.

The author wishes to express his sincere appreciation to manufacturers, publishers, advertisers, and agencies for their permission to reproduce advertisements and editorial copy. Through the courtesy and cooperation of those listed below, illustrations, representing actual copy employed in the research studies, were made available.

American Magazine, May, 1937, Fig. 20.

Armstrong Cork Company, Fig. 35, 36.

Birren, Faber, "The Story of Color," page 277, The Crimson Press, Fig 10.

Black Star Publishing Co., Inc., Fig. 13A, 13B.

Boring, Edwin G., and Hill, W. E., "American Journal of Psychology," 1940, Fig. 18.

Bristol-Myers Company, Fig. 35, 36.

Clark Brothers Chewing Gum, Co., Fig. 81, 82.

Clairol, Inc., Fig. 46A, 46B.

Colliers' Magazine, August 20, 1938, Fig. 38A; August 28, 1938, Fig. 39B; March 22, 1941, Fig. 40, 41.

Cappers Farmer, April, 1939, Fig. 30.

Cowles Magazines, Inc., Fig. 4, 13A, 13B, 14A, 14B, 19, 21A, 21B, 23, 30, 32A, 32B, 42, 45, 46A, 46B, 37, 81, 88.

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Ford Motor, Company, Fig. 20, 33, 34.

Graves, Maitland, "How Good is Your Taste." American Magazine, August, 1941, page 96-97, Fig. 66, 67, 68.

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Life Magazine, March 2, 1942, Fig. 72 (Drawing by Leydenfrost, Photograph by Landry); October 20, 1942, Fig. 33, 34; September 15, 1941, Fig. 47.

Lipton, Thomas J., Inc., Fig. 39A, 39B.

Look Magazine, December 7, 1937, Fig. 13A, 13B; May 24, 1938, Fig. 23; June 21, 1938, Fig. 30; June 30, 1942, Fig. 4, 5.

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Montgomery Ward, Fig. 42, 43, 44.

Marshall Field & Company, Fig. 45.

Morgan, John J. B., "Psychology," Farrar & Rinehart, Inc., page 511, Fig. 56.

N. E. A. Service, Fig. 23.

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Pullman Company, Fig. 20.

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Woman's Home Companion, March 1941, Fig. 35,36.

William Wrigley Jr., Company, Fig. 21A, 21B.

The writer is deeply indebted to the management of Cowles Magazines, Inc., who have provided the necessary funds for the development and construction of cameras and laboratory equipment. As a result of their cooperative effort the research studies reported in this volume have been made possible.

I extend my personal gratitude to my students and associates who have generously given of their time and talent in the preparation of this volume. May we share the hope that these studies may inspire great discoveries in the realm of human conduct.

Des Moines, Iowa
December 1, 1944

H. F. B.

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PART I

PSYCHOLOGY

THE SCIENCE OF HUMAN BEHAVIOR

In scanning the history of science in its manifold aspects we are impressed with the emphasis on its respective phases in different periods of its development. We have had the Era of Astronomy, Physics, Chemistry, and Biology, but it is likely that if the history of science is reviewed 500 years from today the 20th century will probably stand out as the Psychological Century.

Not that these other established sciences are passing but rather that they are finding fulfillment in the new field known as the science of human behavior. Psychology, because it employs the same scientific methods that constitute the basis of other sciences, is considered to-day a science on the par with other fields of investigation.

The physicist, for example, analyzes to the minutest detail the composition and organization of matter in all of its diverse forms and relations and in his quest for the cause of physical behavior returns with the exclamation, "I cannot find energy!" This discovery is not an admission of defeat in scientific research but rather a confession that reality lies in the realm of the intangible.

The biologist in search for the basis of the physiological behavior in man and animals dissects the tissue of the organism to discover their structure and function and their relation to the whole, and he, too, returns with the same refrain, "I cannot find life."

The psychologist, no less, after careful examination of the structure and function of the nervous system and the evaluation of behavior under controlled conditions comes to the same conclusion, namely, "I cannot find the mind."

Whether we seek an explanation for *energy, life,* or even the *mind* itself, in every case we discover the nature and characteristics of these intangibles through behavior of some kind. On the basis of this assumption we conclude that psychology, which aims to interpret the manifestations of human nature, gains its information about the mind by evaluating the behavior resulting from adjustment itself. If behavior is an answer to wants and if the mind is discovered by a careful evaluation of such behavior, it becomes apparent that the study of the behavior of the human eye as a sensory-motor organ becomes a logical approach to the study of mental processes.

To photograph the unconscious adjustments of the human eye and thus reproduce an ocular pattern which becomes a permanent record for scientific analysis is both an art and a science. Such a record yields data indispensable in the interpretation and evaluation of human behavior.

What we know about the human mind has been revealed through behavior of some kind and no single organ of the human mechanism has as truly a sensory and motor function as the eye. This does not mean, however, nor does it even imply that the eye is the only motor organ which reveals to us the mysteries that lie back of its behavior. The glands and muscles of the entire body are all necessary for this evaluation. For

the purpose of this book, however, the writer will confine himself to a study and explanation of the human eye and its manifestations of the human mind.

Psychology defined: Although definitions of Psychology differ, they agree in the main that Psychology is a scientific study of human behavior. Whether this behavior is due to original nature of the individual, to his learned ways of doing things, or whether it is conscious or unconscious, the examination and evaluation of this behavior is called the science of psychology.

There is no mind if there is no behavior—this is self-evident. To say that psychology is the study of the human mind is a misstatement of the case, for to know the mind, life or energy—is to understand their behavior. We judge the level of intelligence of an individual by what he can accomplish just as we judge the strength of a turbine by the amount of electric current it can generate. All intangibles are discovered by what they do.

Scientific psychology is today displacing the unsound practices known by their labels as astrology, phrenology, physiognomy, graphology, palmistry, numerology, telepathy, etc., by an objective method of appraising man and his abilities. Psychology is no longer a name applied to wishful thinking or make believe, it is a scientific method by means of which we evaluate the why of human behavior.

One of the greatest contributions of psychology is that of discovering the abilities of an individual and aiding him in making his adjustment to the complicated world in which he lives. Our adjustment problem is largely that of adaptation

to the changes in our physical and social order. Invention, transportation, communication, and picturization are largely responsible for the many changes to which the individual needs to adjust. No one can prevent or stop these changes any more than we can stop the flow of the water over Niagara Falls, except to direct or modify them to serve ends other than just to flow on.

Aims of psychology: Psychology has as its aims the same objectives as do other sciences, namely, that of description, prediction, and control of behavior. Knowing that this cannot be accomplished without first making a diagnosis of the individual in relation to his situation, the psychologist, as other scientists, is thrown back on his resources of creating and maintaining controlled conditions for his investigations.

Fundamentally the purpose of psychology is to aid the individual, regardless of his status, to adjust more adequately to the changes taking place about him. To be able to adjust properly presupposes first that the individual knows the laws or principles that underlie human behavior, and secondly that he develops habits and adaptability to take advantage of environmental opportunities.

Problems of Research: Two of the greatest problems of scientific research are those of: (1) designing the experiment and (2) controlling the conditions. To design an experiment simply means that whenever the scientist desires to discover whether a certain condition will determine specific results he must know how to set the stage so that his test will reveal whether or not a designated cause was responsible.

The second problem is that of controlling all

influences in order that the variable or condition responsible for the change may be identified. For example, if it is our aim to discover the attention value of red over black and white, we need to control the presentation of it in such a way that neither position nor the character of the design determine for it the added attention value.

The same scientific procedures as are employed in physics, chemistry and biology, are applied in psychology. The scientist in medicine determines the effectiveness of an inoculation for the prevention of diphtheria or small pox by administering the drug to one group and not to another group of his patients. The psychologist likewise introduces a certain condition in one group, and it is generally known as the experimental group, and not to a comparable population, known as a controlled group, to discover the effect of the added stimulation.

The experiments reported in this volume are based on this principle of procedure, and while certain of the groups tested are too small for predictive purposes, they have been selected as representative of the groups tested.

Whenever the term statistically significant is employed, the author implies that the difference obtained, is due to factors other than chance. Chance, as we all know, is responsible for a large variation within limits in a certain group, and by employing a standard statistical procedure, the scientist may determine whether or not the differences obtained are due to chance or to the result of certain conditions known as the independant variable.

Science: In many of the high schools and college text books science is defined as a body of knowledge gathered under controlled conditions, verified and classified for purpose of its practical application. Although many would accept the above statement as an adequate concept of the meaning of science, modern scientists contend that science is mainly a method of discovering the principles of behavior. It matters little, if any, whether this behavior be physical, physiological, or psychological as long as the method is scientific. The aïm of the true scientist is to be able, on the basis of his experiments, to predict that under specified conditions certain results will follow. Modern inventions whether in the medical, educational, or industrial fields are all a product of scientific research and serve as instruments personifying predictions and control in the minds and hands of civilized men.

Psychological Problem: The two major problems in the analysis of psychological processes of individuals have always been (1) to gain adequate information from the subject without causing him to become self-conscious in the experimental situation and (2) to learn from the subject the exact nature of his experience. If verbal or written reports are required a premium is placed on introspection; the data thus obtained is more or less subjective and, consequently, the entire experiment is affected by it.

METHODS OF OBSERVATION

Every field of human knowledge begins with very simple and crude methods of observation,

and what is considered an excellent method of scientific investigation in one generation may be obsolete and impractical in another.

Accurate observation is essential in obtaining scientific information and differs from ordinary observation in six ways:

In the purpose of the observer.
In the selection of behavior to be observed.
In the way conditions are controlled.
In the kinds of instruments employed for measurements.
In the statistical treatment of the obtained data.
In the completeness of the report of the experiments.

The main difference, then, between ordinary and scientific observation lies in the fact that the latter type of observation follows definite rules and restrictions under which the observations are made, while the former observes as time and chance permit. The difference is similar to playing a game with or without rules.

Subjective method: In psychological research two types of observation are employed. One is known as introspection or subjective observation and the other is objective. Introspective observation is simply the observation of one's own experience. Psychology differs in this respect from other sciences. In all other sciences the object or animal observed cannot give verbal information relative to its own feeling, thinking, or acting. Animals, for example, cannot report which of two kinds of food tasted better, to them, or whether they would rather sleep in a barn, in a tent, or out of doors. The physical world has even less to say to us in this respect.

Observation which relies wholly on the reports of the individual's experience has decided limitations. First, the period is too brief for observa-

tion; secondly, the individual is as a rule not trained to observe his own acts; and thirdly, his report cannot be checked or verified by others except as another type of observation is employed.

For one to study his own behavior without provision for others trained in the science to verify the observation is at its best a questionable procedure for obtaining authentic information about human conduct. Information, in order to be acceptable, should be obtained from individuals trained in the science of observation. In that case it is altogether possible that even subjective or introspective psychology may throw additional light on objectively observed facts.

Objective method: The other type of observation is known as objective. When employing this type of observation in an experiment, only behavior in a situation is recorded. These responses serve as information for the what, how, and why of behavior. It is simply a record of what the subject does under certain conditions. Again the report is a description of the behavior of the individual.

Objective observation, when properly controlled, is considered a scientific procedure when the rules of observation are followed. The main difference between subjective and objective observation is that the former method relies on reports made by the one subjected to the experiment, while objective observation is a report made by the observer of the behavior of his subject.

The two methods of observation are simply illustrated by asking the individual which pages of a magazine he has read or observing him

without his knowledge and recording the exact time spent on each part of the periodical. It is apparent that to rely on his report of what pages he had seen or how much time he had devoted to each would be unreliable for scientific research purposes. Since the aim of scientific psychology is to obtain accurate and authentic information about the behavior of individuals, it is imperative that data which cannot be verified should be reduced to a minimum.

Psychologists, today, employ the same scientific methods as are utilized in other sciences. Instruments of precision and controlled observation constitute the major conditions of the test to evaluate the behavior of individuals for purposes of predicting and controlling their behavior.

To describe, predict, and control conduct is simply to know how to manipulate conditions responsible for it. This is clearly demonstrated in the mechanical world wherever certain procedures predetermine certain results. For example, step into your car, fit your key into the lock, give it a twist of your wrist, step on a gadget on the floor, and the motor purrs. We do this so frequently and so habitually that we rarely stop to think that we have been prophetic in the sense of:— "Didn't I tell you so?" The exception is such that predicted behavior suffers when car fails to move. We can, with the same assurance, predict that the car will not start if one of these conditions is missing, be it gas, spark plug or the car key.

This, you say, is physics pure and simple. But by the same token we can administer an intelligence test to a child 10 years of age; if he makes

a score which is equal to an intelligence quotient of seventy-five we can with assurance predict that he lacks the ability to complete the studies required in the first eight years of school. Advertisers, artists, salesmen, as well as educators provide conditions which they believe will result in certain modes of conduct. If they fail, it is evident that they had misjudged conditions or overlooked certain processes already in operation; hence, their prediction as well as their control failed to materialize as they had anticipated.

In order to make an accurate analysis and diagnosis in the field of visual science, adequate instruments of precision are indispensable. Just as in the development of civilization the discovery and application of tools has made for culture and progress, so in experimental psychology instruments of precision, properly employed, have led to far reaching psychological advances.

Criticism of modern psychology is directed not so much against apparatus and techniques employed in psychological laboratories but, rather, against the use of physiological mechanisms explaining complicated perceptual operations. For that reason there has been a tendency to question the efficacy of the traditional theories explaining such central processes as attention, perception, learning, thinking, etc., and it is only natural that these theories should be subjected to the experimental approach of scientific laboratory methods. Experimental psychology is not limited to the arm chair philosophy of a certain school but rather aims to discover by some scientific technique the psychological processes involved in a specific field of human behavior.

Ocular Photography: Ocular photography as a laboratory technique has minimized the two major difficulties stated earlier. In photographing the eyes of subjects, individuals are not conscious of their eye movements as they are of their response when required to talk or walk, or even when they have their faces or figures photographed. Since the eye movements are unconscious adjustments of the individual to the demands of certain stimuli or psychological needs, we as experimentors are in a fortunate position to catch with instruments of precision these honest, frank, and trustworthy behavior patterns for our analysis.

Eye movements, serving as objective symptoms of perceptual processes, are readily discovered and effectively located although the underlying motives may not be known at the time to either subject or investigator. Whether the subject is studying a problem with the intent to solve it, whether his eyes are caught by the appeal of an advertisement, or whether he merely looks at a picture for appreciation, in every case the eyes follow a definite course as truly as a stream winds its way to a certain destination. The underlying causes for a given type of behavior are non too well known, but by proper and patient analysis, research will discover the underlying causes of eye movement behavior in their relation to the environment. It recognizes the possibilities in the field if the technique is properly applied.

As a technique, Ocular Photograhy is not new, but its application and the types of subject matter studied are new. Preceding the present eye camera, records of eye movements were

obtained by studying the after image, by attaching apparatus directly to the eye, by direct observation, and by recording the eye movements by means of mirrors and eye lid attachment. All devices in one way or another were developed for the purpose of charting the course of the eyes while in motion.

Optical instruments have enabled the practitioner to work with the eye as an organ of vision, but the technique of photographing eye movements enables the psychologist to see the eye in motion and thus interpret behavior in the light of such adjustment. Still further improvements and refinements in the technique of recording eye-movements are being made and are now in the process of development, in order that a more adequate control and a more diversified study may evolve.

Points of view: In attempting to establish a point of departure for seeking relationships between eye movement and central processes, and their psychological implication applied to novel situations, one is confronted with two, or possibly three, theories. One theory holds that poor central processes are due in part to inefficient eye-movements habits, and that special training in eye-movements would result in a more efficient procedure.

The other school contends that eye movement habits are not the cause of the particular mental activity, but rather that central processes determine the characteristic nature of the eye movements themselves.

A third point of view would naturally imply that there exists a functional relationship be-

tween ocular movements and central processes. This view recognizes both receptor and effector as a necessary part of the mental equipment to produce what is commonly known as mental activity.

Theoretically, as well as practically, one encounters innumerable difficulties in ascribing a relative degree of cause and effect to respective media of a process. However, in ascribing to the receptor and the effector mutual interdependence, one is not likely to lose sight of the importance of the sensory channel in presenting subject matter to the individual or to underestimate the importance of the motor responses in conscious activity. Although the author of this study believes that the eyes stand ready to serve the central processes and do their bidding, he also contends that inefficient central processes over a period will result in faulty eye-movement patterns which will hinder efficient observation and learning.

DETERMINERS OF OCULAR PERFORMANCE

As already indicated, the variation of the location, sequence, frequency, and duration of fixation of eye movements depends, as does the distance and direction of excursions, upon conditions of the individual and his environment.

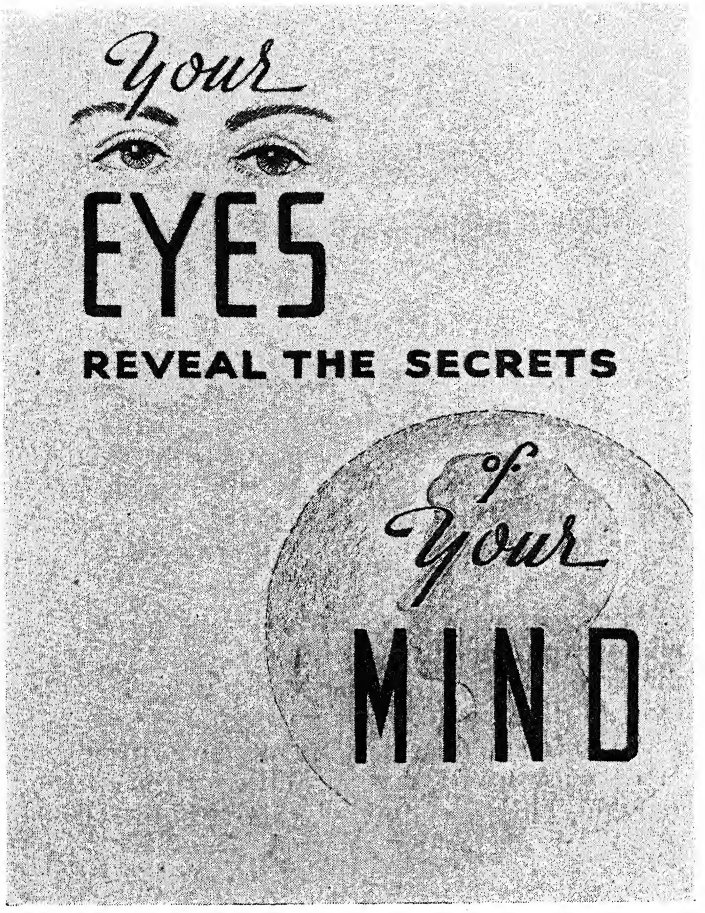
The intellectual capacity of the individual due to past experiences, his formal training, and the purpose of the observer at the time, all in one way or another play a definite role in determining the ocular performance. The ocular pattern when recorded by a camera, becomes a permanent record of the performance for a giv-

en task and stands as evidence of the nature of the sensory and motor experience of the observer. Ocular patterns become meaningfull only when fixations, time, excursions, and space are adequately measured by laboratory instruments and when the interpretation is based on such accounts.

To think of the mind in terms of physical dimensions seems altogether logical when we remember that our mental content is comprised of sensory experiences which come to us in forms of intensity, extensity, protensity, or a quality of some kind. It is only fair to believe that our approach to the study of the human mind should follow directly the course charted by human conduct.

Eyes Reveal Your Secrets: This, believe it or not, may be one reason why some people will read this volume. "Your Eyes Reveal the Secrets of Your Mind." "This," the individual says, "is correct. I have always believed that the eyes tell a story if I could only learn the secrets that lie back of these orbits."

A few prophetic statements about your eyes by an analyst will give you the same confidence that you experience when placing your trust in other superstitions if you believe in them. If you have round eyes you are trustworthy, likeable, and unsophisticated; if you have oval eyes you are not easily fooled but are temperamental and emotional. Long slanting eyes, you know of course, single individuals out as secretive, clever without possessing great brilliance, but sensitive to personal remarks. If you have large protruding eyes you may be a rather bombastic person suffering from extremes of generosity and selfishness. Small, oval and piercing eyes



reveal that you are quick witted, keen-minded, and even tempered.

And so we could go on and look into all the color clews and eye tricks and leave you just where we found you; namely, inquisitive about what your eyes reveal about your character and personality. Quite the contrary to what you would expect a writer of a book of this kind to say is that eyes not in motion have litttle if any expression which would predict the abilities or aptitudes, honesty or deceitfulness of individuals.

To look at people's eyes may give you eye-deas but they may have no greater predictive values than judging the contents of a book by its cover. In studies of emotion it can be demonstrated that when the mouth and eyes of an angry and happy person, judged from a photograph, are interchanged, the mouth rather than the eyes determines for the individual the emotional state. Our eye balls are more like marbles and whatever character traits are read into them depends more upon the reader than the possessor of the eyes.

The writer in his research studies does not photograph the eye. He is not concerned about the color of the iris, the wide awake or sleepy look of the eyelids, nor the beauty of the eyelashes. He is concerned about what the eyes do in response to a situation. This to him is fundamental. This reaction reveals to him the real secrets of the orbits at work.

PART II

INSTRUMENTATION FOR OBJECTIVE OBSERVATION

In 1937 the author published a description of a camera which would photograph the eye movements in the bidimensional plane on a single film. This was a decided improvement over other instruments of its kind since it reduced the amount of film used by 50 percent, facilitated the loading and unloading of the camera, and eliminated the problem of synchronizing the two films. Since that time, innumerable changes have been made in the apparatus, thousands of subjects have been photographed, and as a result an equal number of ocular patterns have been projected and analyzed.

The principle of ocular photography (known as the corneal reflection technique) is valid as a means of obtaining an accurate record of eye movements. With the developments and improvements made in the new bidimensional camera utilizing this principle the technique is made practical for research purposes.

Findings of the Visual Research Laboratories have revealed that ocular patterns, resulting when reading a book, looking at advertisments and pictures, or solving a problem are indicative of the mental processes involved. The confidence of being able to evaluate physical and psychological variables by means of this technique has prompted the author and his associates to spend much time and money to perfect the necessary equipment and technique.

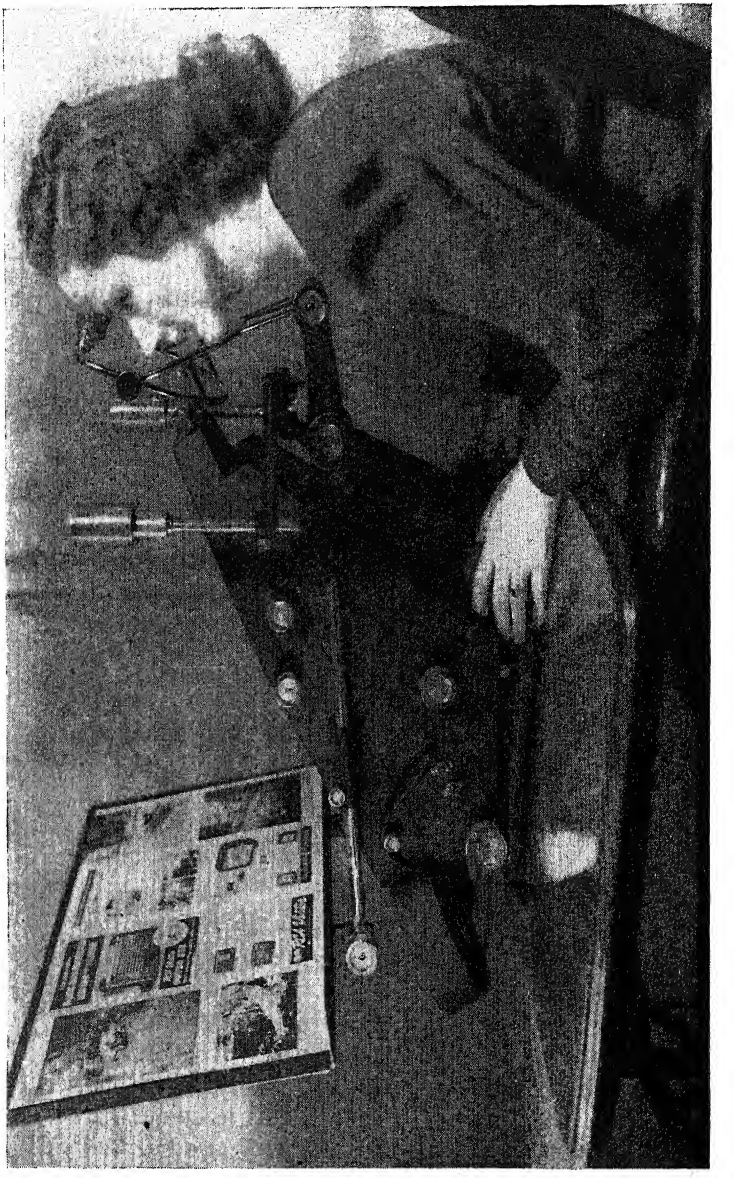


Fig. 1—A portable bidimensional camera (invented by the author) U. S. Pat. 2,229,721. Camera records every fixation and eye movements of subject while reading, looking at pictures or working problems.

Construction: The construction of the camera, as illustrated in Fig. 1 is of aluminum material, except for moving parts and, consequently, is light in weight. The overall dimensions of the machine are 43cm long and 20cm wide, and the distances from the telescopic lenses to the film is 29cm.

Telescopic lenses: This intermittent camera is equipped with achromatic lenses which, because of the focal correction, increases the transmission of light 100 per cent over other cameras of its kind. The use of these lenses makes possible the inexpensive motion picture film. The lenses are 2 cm in diameter permitting considerable head movement without distorting the line of regard directed within the limits of the lens housing.

Head movements: Since most reading of print, pictures, or advertising copy is accompanied by some head movements, a device known as a false eye was constructed which attaches to the subject by means of a pair of frames. Any head movements occurring during observation are recorded on the film and provide a point of reference for compensation.

This reflector (false eye) is the same distance from the film as the seeing eye and has approximately the same curvature. Previous head movement reference devices were attached either to the forehead or the nose, and head movement with such a device registered a greater deviation than that recorded by the moving eye.

Magazine rack: To provide adequate space upon which to place reading copy the intermittent mono-film camera is equipped with a rack which will accommodate a full spread (double page) standard-size magazine, e.g. *Saturday*

Evening Post, Life, Look, Colliers, etc. This rack is adjustable and may be moved closer or farther away from the subject, while at the same time the angle of the holder may be changed to accommodate the observer for his purposes.

Signal key: The camera is equipped with a device known as a "contact key." This control is placed in the hand of the subject and whenever he turns a page or gains an answer to a problem, a light is flashed on the film and a record of the time and place of the reaction is indicated.

Adjustments: The camera is equipped with four major adjustments. Ratchet No. 1 (Fig. 1) moves the telescopic lenses toward or away from the subject for purposes of focusing the image on the film. Ratchet No. 2 rotates the camera in the vertical plane, while Ratchet No. 3 moves the camera from left to right to accommodate the subject. Ratchet No. 4 opens and closes the view finder and is employed when focusing the subject at the beginning of each sitting.

Not only is this camera adjustable in all of these different ways, but the table, too, is adjustable to accommodate subjects of different proportions. In place of adjusting the subject to the camera, the camera is adjusted to each individual instead.

Operation: The principle of the operation of the camera is based on the fact that the human eye in focusing a certain point rotates in such a way that the lines of regard strikes the fovea of the retina. The fovea is a very small area at the back of the retina where vision is clearest.

Two small beams of light emanating through small openings from tubular housings are reflected from each of the two eye balls in such

a way as to create a small spherical high light on the surface of the corneas. The light reflected from the cornea of the eye balls is carried down small telescopic tubes provided with acromatic lenses which focus the beams of light on a 35mm motion picture film.

By means of this arrangement the motion picture film, moving at a constant speed and stopping intermittently to catch the eye in its new location, photographs the eye fixation as a tiny dot on the film. Each fixation of the eye changes the high light on the cornea and, consequently, is focused at different points on the sensitized film.

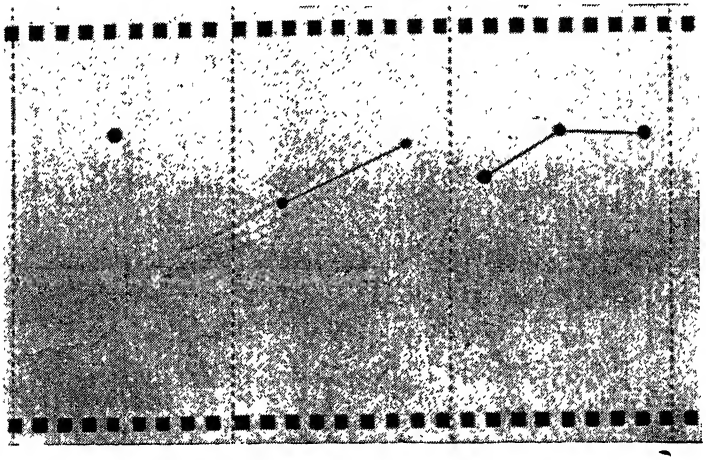


Fig. 2—Each dot represents an eye fixation on the film resulting from the observation of a given field.

Since the reading takes place during the pauses and since each one of these pauses is recorded as a dot on the film it is obvious that one who can comprehend a larger number of words or larger area of picture in one fixation

makes fewer fixations per line of reading or space of pictorial content.

Projection: The film, after it is processed, is placed in a high powered steriopticon and projected on a field equivalent to the pages originally observed by the subject. Since each eye fixation is recorded on the film as a single dot, the analysis of the record is a simple matter when projected. As the eyes move over the test materials, dots are recorded on the film in exact relationship to the points where the subject looked on the page.

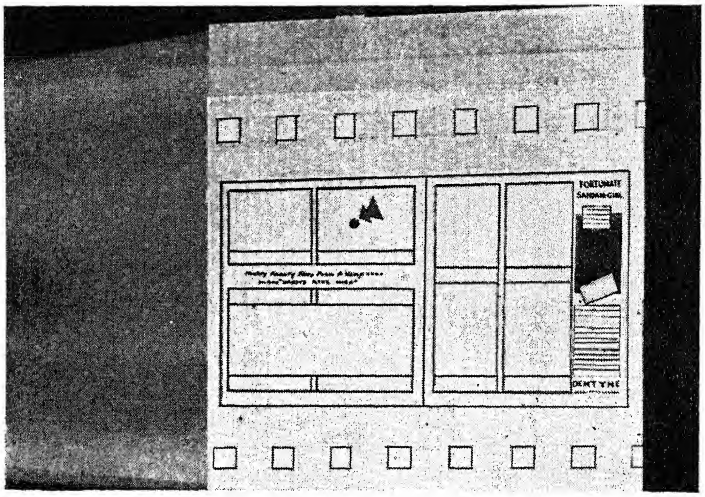


Fig. 3—Projection of film with eye fixations falling on respectives areas.

If, for example, a fixation falls within a certain area of a given field, the eye fixation as projected will fall within that area. Areas are constructed for each type of material projected.

Ocular patterns: Fig. 4 illustrates a typical eye pattern obtained by means of Ocular Photog-

raphy. The location of each fixation is determined by the relative deviation of the eye in its rotation from the original reference point, and the duration of fixations are measured by the number of frames the film moves per second. An ocular pattern indicates the duration, location and sequence of every fixation as well as the distance, direction, and frequency of every excursion or eye movement.

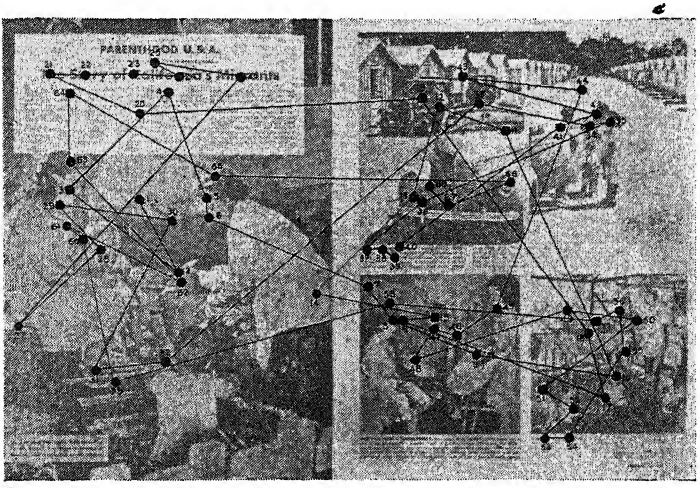


Fig. 4—Illustration of an ocular pattern of a subject looking at a two page magazine spread.

Advantage: The major advantages of this camera as research apparatus over earlier cameras are that:

This camera photographs not only the horizontal eye movements but records all eye movements in every direction.

The apparatus is light in weight and small in dimensions. Its portability lends itself readily to research in laboratories, schools and offices alike.

The cost of film is negligible in price since only one film is required in place of two, and records are photographed on inexpensive recording stock.

Since only a dot is recorded on the film for each fixation, the record is easily projected and readily analyzed.

Fig.5—Relative time in per cent spent by 100 subjects in respective areas of layout.

One hundred subjects, fifty men and fifty women, observed in the course of reading the entire magazine. Subjects spent an average of twenty-three seconds on this spread. This constituted 2.12 percent for the men and 2.92 percent for the women of the total time devoted to reading the entire magazine of thirty-one pages. The average reading time for each spread was thirty seconds or 16.53 minutes for the entire magazine.

Cumulative record: By means of this technique, the course the eye travels is revealed for each subject. In addition, however, the relative time subjects spend on respective areas of a picture, advertisment, or editorial may be calculated.

Fig. 5 is an example of the relative time 100 subjects spent in respective areas of a double page magazine spread. More time was spent in areas two and four than in all others combined. It is also obvious that much more time has been spent on pictures than on the printed copy of the layout.

Application: This mono-film bidimensional camera, which is portable in construction, compact in organization, and streamlined in design, provides an efficient, flexible, and reliable intrument for research in laboratories, schools and offices. It is economical in operation and practical for various types of visual research.

Due to the tremendous demand for an instrument which will acurately and efficiently photograph the eye movement in the bidimensional plane this camera was constructed. Whether the investigator is interested in the attensity of physical variables such as position, size, color, isolation, etc., or whether he desires to evaluate the ocular patterns resulting from interests, intelligence, aptitudes, and purposes of different individuals, the camera provides a convenient, economical, and scientifically accurate apparatus.

This new camera provides for the turning of pages so that a subject may spend as much or as little time on each page as desired.

To photograph the unconscious adjustments of the human eye and thus reproduce an ocular pattern which becomes a permanent record for scientific analysis is both an art and a science. Each eye fixation as well as every excursion implies certain physical, physiological, and psychological implications which may be revealed by this technique. Extensity and protensity, measures of time and distance, can be accurately evaluated when photographing the performance of the eye in motion.

With an instrument such as this which provides an objective record of ocular performance, a vast field of information heretofore the subject of guess and speculation can now be investigated scientifically.

PART III

BASIC EYE MOVEMENT LAWS AND TENDENCIES

In studying the ocular performance of the human eye it is imperative that we understand the characteristic eye movement tendencies. In order to better understand these tendencies we will consider briefly their various components.

Fixations: Contrary to common belief, the eye does not glide over the picture or along the line of printed matter. It covers the area in jumps and stops which are known as fixations and excursions or eye movements. The human eye makes an average of four fixations per second. This would be equal to about 240 per minute or 14,400 fixations per hour. If these eye movements were converted into sound so that we could hear them, it would be like listening to the ra-ta-ta-tat of a machine gun. Under such a demonstration as this, one would be even more impressed with the consistency or inconsistency of the ocular performance of the individual.

The eyes at work provide us with a different concept of their functions and importance than we are able to obtain when observing these sensory motor-organs in a static state. The duration of successive fixations varies from five hundredths of a second to a second or more, depending upon the kind of material observed and upon the ability, interest and habits of the observer. Clear vision takes place only when the eye fixates. The eye is being temporarily blinded while in motion. For an example of this prin-

ciple, look in the mirror to see whether you can detect your eyes in motion.

Excursions: The excursions, so called, are the movements of the eye from one fixation to another. The distance of the respective eye-movements during the observation of a given field varies from a few millimeters to a distance stretching completely across an entire observed area.

Excursions are anticipatory and hence are for the purpose of orientation. Whether consciously or unconsciously, each eye movement accepts as its main purpose the task of adjusting the line of regard in such a way that it may see more clearly and organize more adequately the content under observation.

PREFERRED POSITIONS IN HUMAN EYE MOVEMENTS

Left and Top position preferred: To discover whether the eyes themselves tend to follow a consistent pattern or whether they move at random without rhyme or reason has been the major objective in all of the research studies. In attempting to discover basic eye movement tendencies as revealed by the ocular patterns the following questions present themselves:

When observing a symmetrical field where does the eye look first, second, and third?

Has the eye a preference for the right or left side of the page?

Is the upper or lower half of the page preferred?

Does the eye prefer vertical or horizontal excursions?

To determine certain basic eye movement tendencies a white card, 10x10 inches, cross ruled

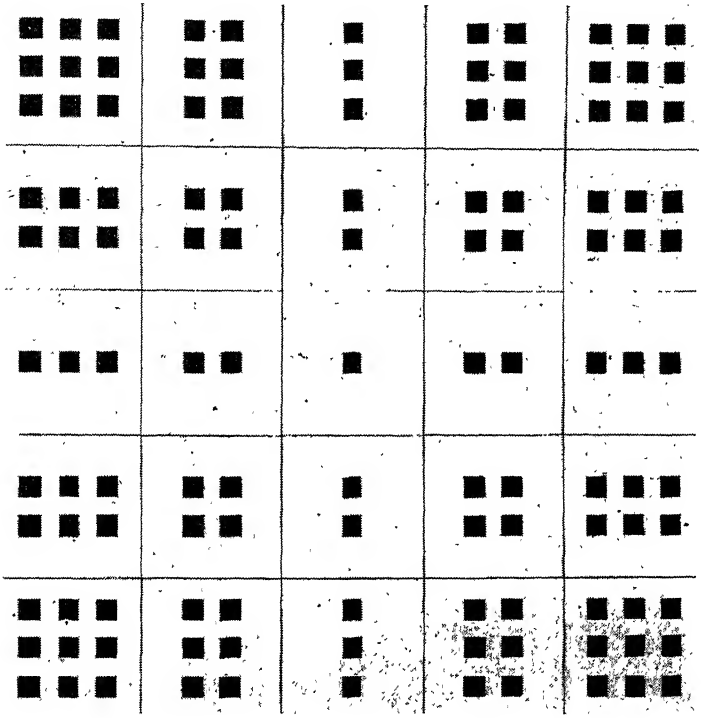


Fig. 6—An exposure card designed for observation.

into twenty-five equal areas each 2x2 in. sq. was constructed. Every cross-ruled division contained from one to nine small black squares each 1/4 in. sq. These were symmetrically arranged around the center one which contained one black square. Proceeding outward from the center the number of small black squares were increased uniformly in every direction. It is apparent when observing the figure, that the same

arrangement exists on all four sides of the design. Because of this arrangement, there should be no preference pattern in the field.

Fifty college students chosen at random observed the exposure cards for twenty seconds. Preceding the presentation of the card each subject was instructed to study the pattern or design of the cards with the intention of reproducing it from memory later. He was not, however, informed of the length of the exposure time.

The results of the study reveal that the median of the first fixation for all subjects falls at

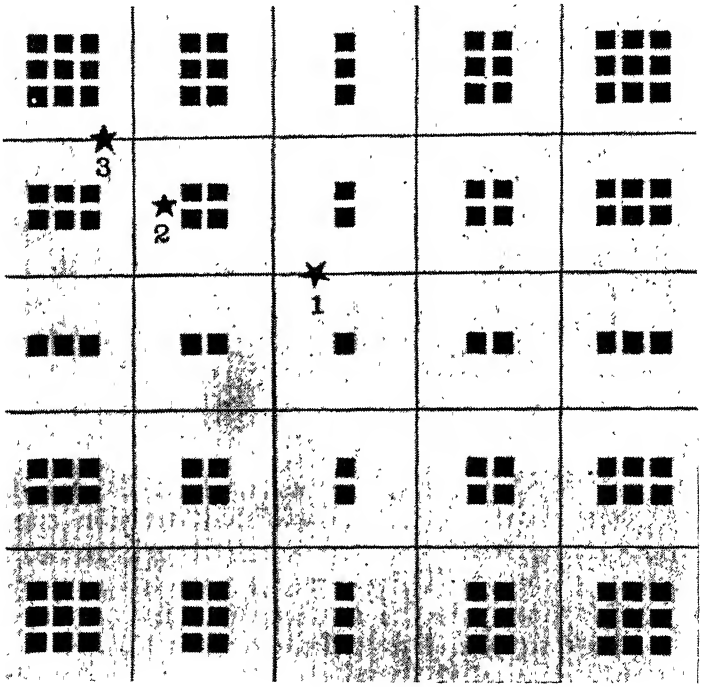


Fig. 7—Median location of first, second and third fixations of a symetrical field.

a point above and to the left of the center of the observed field.

Since the first fixations fall at a point to the left and above the middle of the page, the advertising or art layout which utilizes this principle will have many advantages. First, the eyes will not be distracted at the beginning of the survey; secondly, the direction for the course of eye movements can be initiated here; and thirdly, the mental content or idea can have a right of way rather than to be forced by the physical stimuli of the presentation.

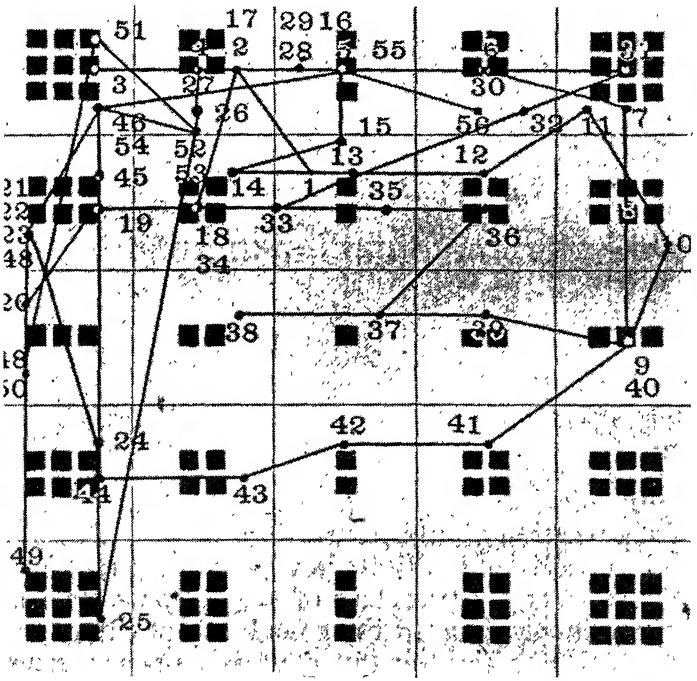


Fig. 8—A reproduction of the ocular pattern of subject 15.

In order to illustrate the characteristic eye movements of the subjects an ocular pattern is reproduced in Fig. 8

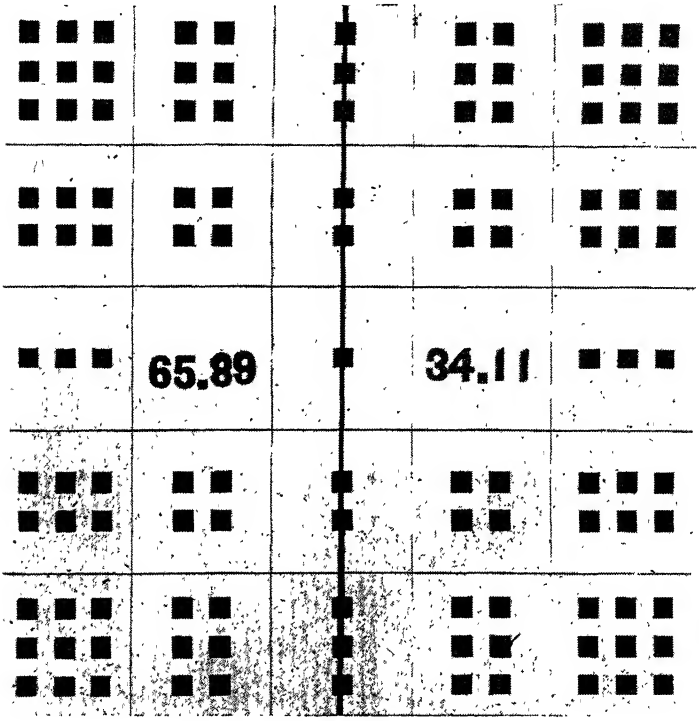


Fig. 9—Relative time in percent spent on right and left side of page.

An adequate layout based upon this principle of observation would naturally organize all physical stimuli to facilitate the idea or purpose of the observer. The nucleus of the story would find a prominent place in the so-called optical center, in order to gain for the reader a proper orientation which would ultimately lead to a satisfactory completion.

The distribution of time as indicated in Fig. 9 shows that there is a strong preference for the left side of the card. Fig. 9 indicates that 66% of the subjects' total time was spent on the left half of the page and only 34% on the right half of the same area. The conclusion to be drawn from these results is that position is an important determinant of attention.

The left side preference is most likely due to our habits of reading and a type of brain dominance. In reading a printed page, it is necessary for us to move to the left when begining the first line as well as when returning to the next line of print. This habit, in all probability, has a very definite influence on adult observers in predisposing them to move toward the left. Poor reading among children is frequently due to an inability to read from left to right, a habit which is definitely a result of poor training. Just how one, having read no language other than Hebrew, would respond to such a test is not known at this time.

Another reason for the left side preference seems to be a physiological rather than a psychological one. Right-handed persons are generally left brained; since the left hemisphere of the brain controls the right side of our bodies, it is postulated that in a right-handed person the left side of the brain dominates. Dallenback and his associates advance a neurological explanation by saying that, "neural excitations aroused in the right retinas of each eye—the areas stimulated by objects occupying positions to the left of the fixation—center in the right hemisphere of the brain where they, because right-handed people are left brained, are comparatively free from

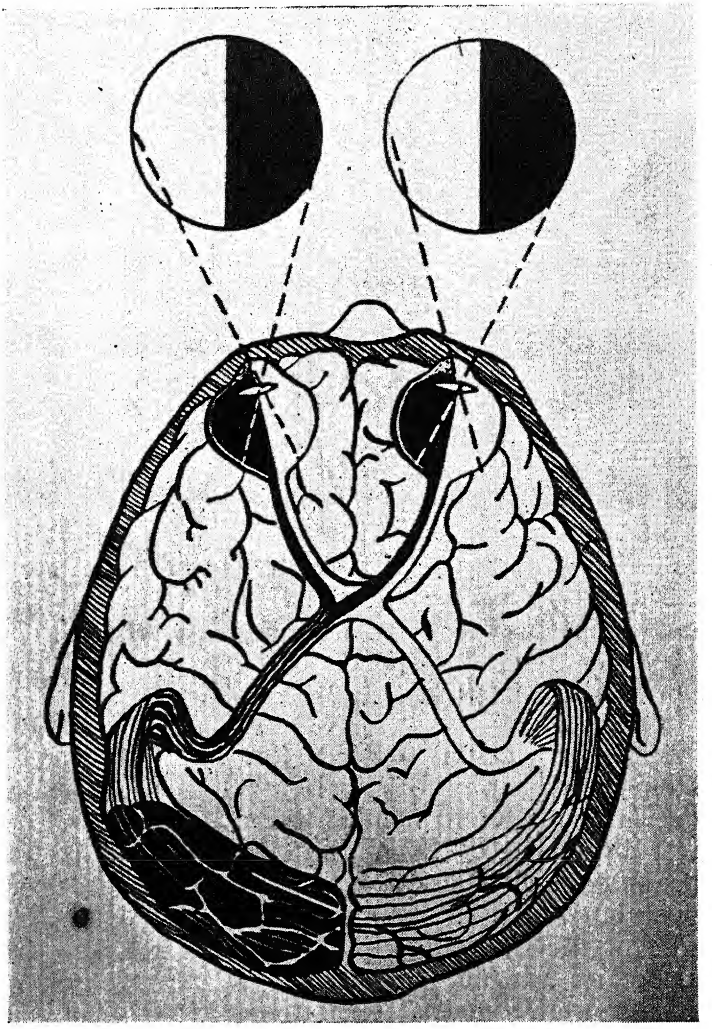


Fig. 10—Diagram illustrating the principle that stimuli originating to the left of a designated point give rise to a mental response in the right hemisphere of the brain and visa versa.

interference and inhibition by other concomi-

tant processes . . . Everything else being equal, objects arousing processes in the right brain would enjoy, therefore, an attentional advantage over all others."

Experimentation has revealed that, when two lights are exposed simultaneously to observers who are right-handed these observers will judge the light on the left more intense than the one on the right, even though the intensities of the two lights are of equal intensity according to physical measurements. Left side preference, based upon the above explanations seems to be due to both native and acquired behavior patterns and hence is fundamental in determining certain basic eye movement tendencies.

Another eye movement tendency is that of preferring the top to the bottom position of a given page. Fig. 11 indicates that 61% of the subjects total time was devoted on the upper half of the page while only 39% of the time was spent on the lower half.

When calculating the relative time spent in each of the four quarters of the field it is found that the percentage of time, 41 percent, is spent in the upper left-hand corner, 25 percent in the lower left, 20 percent in the upper right, and 14 percent in the lower right. The two extremes as can be readily seen, are the upper left and lower right. This is due to the ocular tendencies as explained earlier. The upper left has the advantage of the left and the top, while the lower right has the disadvantage of the right and the lower half of the page. The lower left and the upper right have the advantage of one position and the disadvantage of the other.

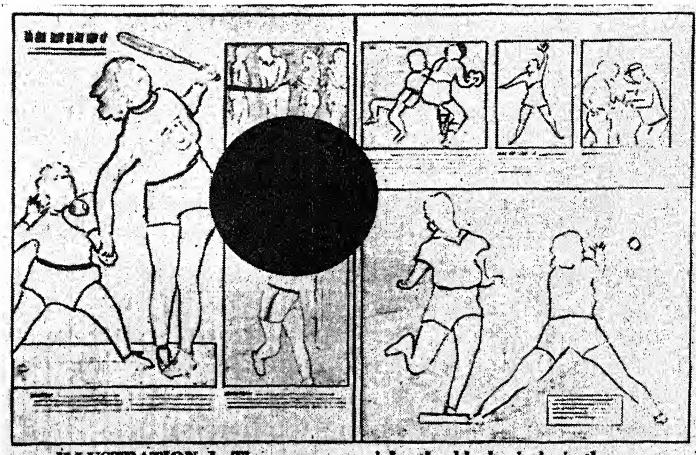


ILLUSTRATION 1. The area covered by the black circle is the approximate "primary area of fixation" on a two-page magazine spread, according to results of eye-camera tests on more than 3,500 subjects. *Note: This rough layout has been used solely for illustrative purposes.*

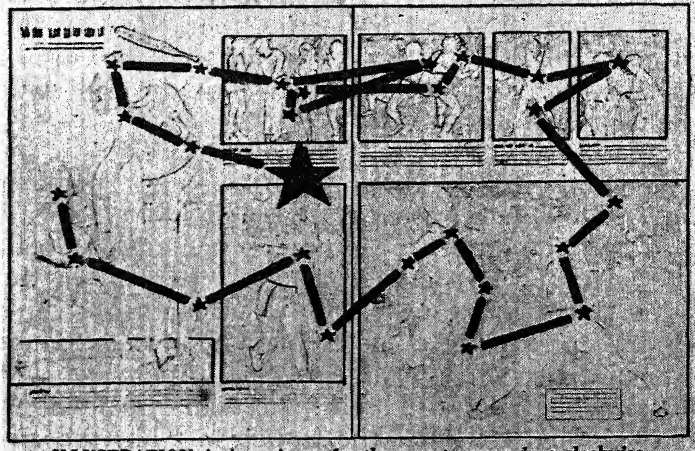


ILLUSTRATION 4. A tendency for the eyes to move in a clockwise manner in their first exploratory trip over a new layout area has been observed in many eye camera tests made with widely differing conditions and layout situations. However, a change in this flow of movement has been effected with particular layout techniques.

Fig 11A—Illustration, eye movement tendencies.

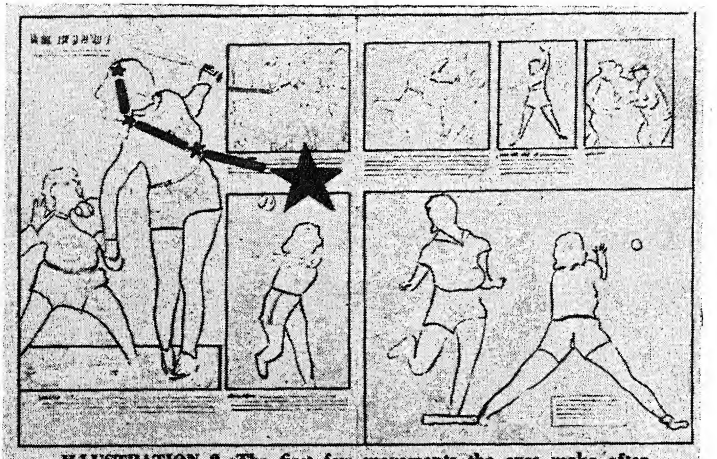


ILLUSTRATION 2. The first few movements the eyes make after striking the layout area are to the left and upwards. The tendency to move first to the left is one of the strongest indications.

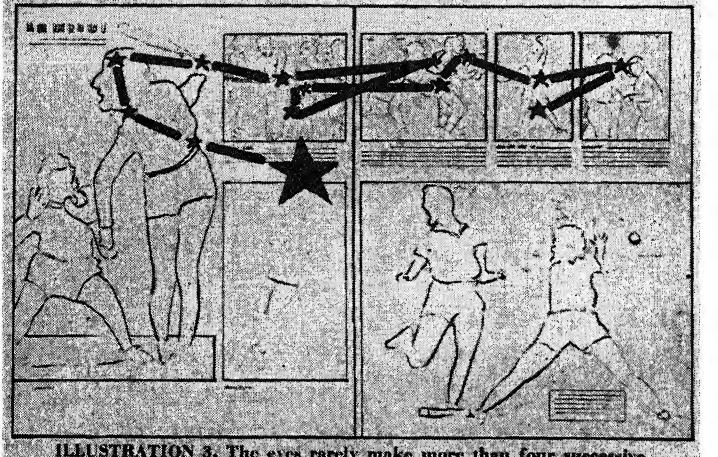


ILLUSTRATION 3. The eyes rarely make more than four successive movements in the same direction. As indicated above, the eyes moving generally from left to right changed direction several times. This tendency does not apply merely to pictorial layouts, but has been noted in tests on symmetrical fields of symbols, dots, etc.

Fig. 11B—Further illustration of eye movement tendencies.

TABLE I

Relative Frequency of Fixation in the Different Sections of the Visual Field.

Position	Mean	S. E.	Mdiff	S. E. mdiff	CR
Left (freq.)	41.86	1.87	21.74	2.15	9.35
Right (freq.)	20.12	1.61			
Upper (freq.)	40.62	1.43	17.64	2.58	6.82
Lower (freq.)	22.98	1.85			

Following this type of analysis many subjects have been photographed and their ocular pat-

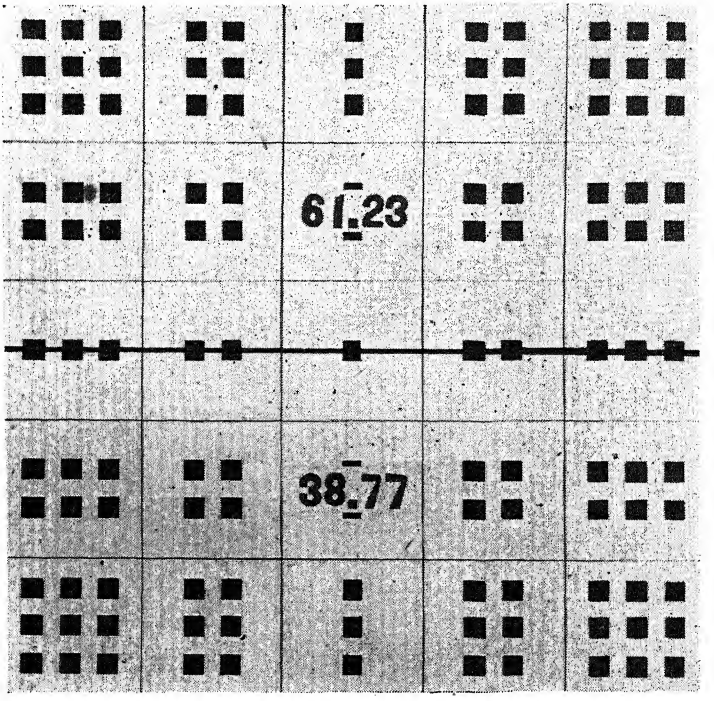


Fig. 12—Relative time in percent spent on the upper and lower half of a symmetrical field.

terns evaluated in terms of the above findings. The principle of left top preference has been found to be consistent and statistically significant. On the basis of these findings a composite ocular pattern has been constructed (Fig. 11) to illustrate a typical course an eye follows when observing an ordinary two page spread in a periodical.

Succesive movement of the eyes following the initial fixation is toward the left and upward. To move toward the left is one of the strongest tendencies in ocular performance. Rarely do the eyes make more than four movements in the same direction. They have a strong tendency to move in a clock wise manner in the first exploratory trip over a layout. The ratio of excursion frequency as well as excursion distance is about two to one in favor of horizontal movements. In other words, eye movements are facilitated horizontally and inhibited when moving vertically.

TABLE II

Relative Frequency and Distance of Eye Movements in the Horizontal and Vertical Planes Respectively

(Distance in Centimeters)

Position	Mean	S. E. m	Mdiff	S. E. Mdiff	CR
Horizontol (freq)	35.34	1.6	14.38	.84	17.0
Vertical (freq)	20.96	3.4			
Horizontal (dis)	1955.98	102.1	862.93	16.31	52.8
Vertical (dis)	1093.05	86.1			

Two general types of eye movements are commonly employed by the average individual. One is the exploratory type in which the individual makes a general survey of the entire field under observation, and the other is a more detailed examination in which the subject returns to the

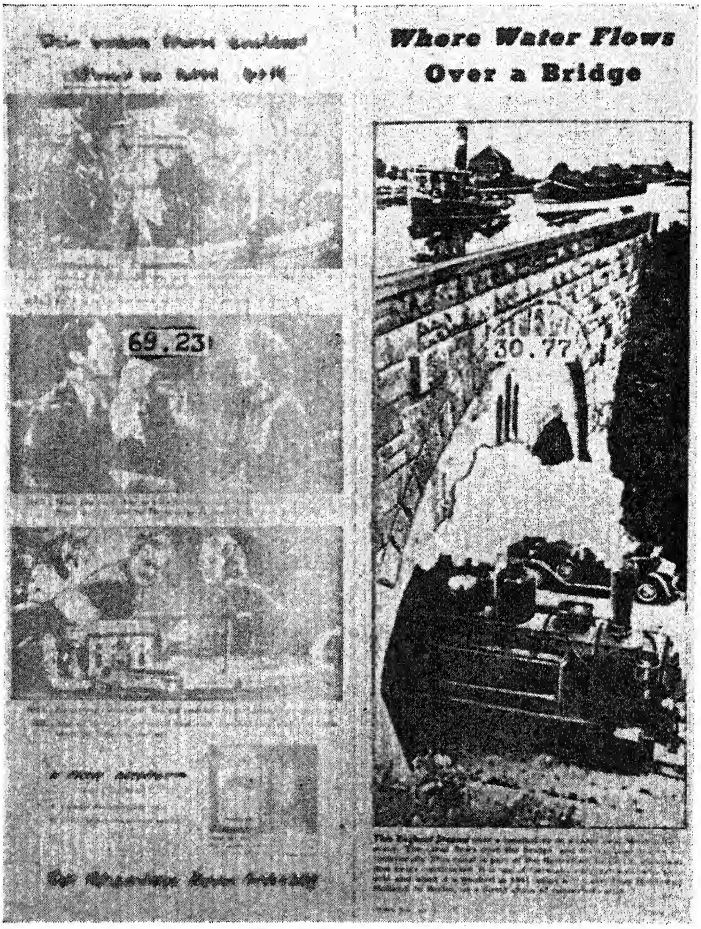


Fig. 13A—Subjects observe for a period of 15 seconds

areas observed earlier for a clearer inspection. It must be remembered, however, that regardless of how strong these tendencies may be, they can all be altered when different types of layouts are introduced or when the purpose of the reader is at stake.

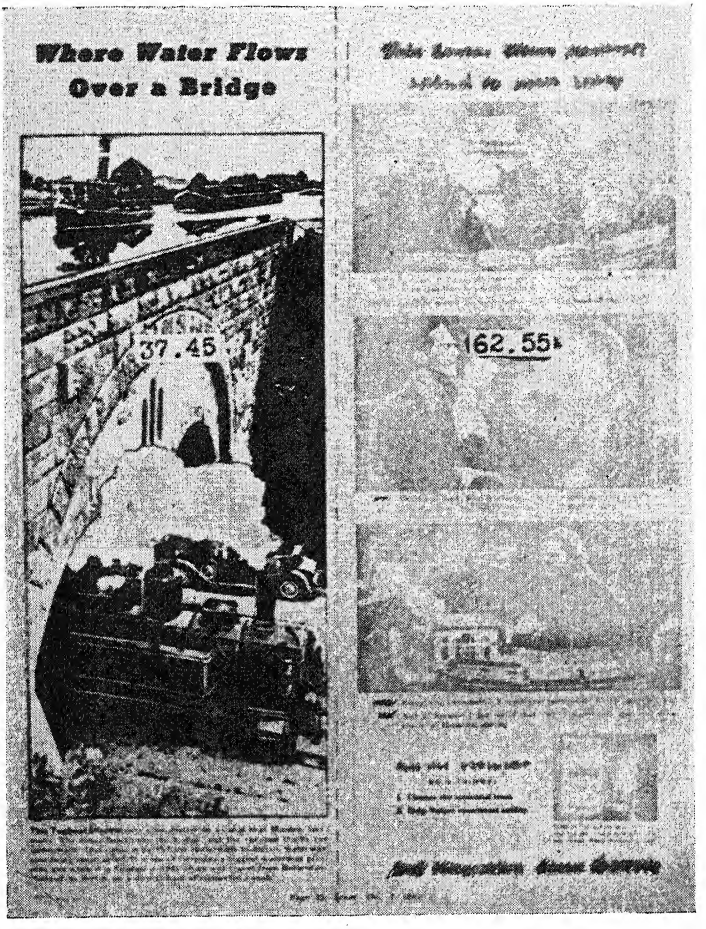


Fig. 13B—The same layout as 13A with pages reversed.

The principle of left side preference is illustrated in two different layouts of an editorial and advertising copy. Although the advertisement receives more attention regardless of

whether it is in the left or right hand position, this is no more a contradiction of the law of left side preference than when an airplane seems to defy the laws of gravity. The right side preference, in this case, is due to the fact that the editorial is not sufficiently strong to compete with the interest in the advertisement.

Both the editorial and the advertising copy receive more attention when they appear in the left than when appearing on the right hand side of the page. By reversing the editorial and advertising copy from left to right hand position and vise versa, the influence of the position factor can be measured.

Advantage of center position: Left and top position preferences are significant and should not be discounted or over-looked by art and advertising layout experts, but in addition, another position factor should be considered. This factor is the relative influence of center position as contrasted to the outer position on a spread.

To test the relative attention value of center and outside positions, fifty subjects looked at the two page spread illustrated in Fig. 14. The two pages were reversed in postion in order to place the two outside columns in the center and thus determine the relative influence of this variable in the two positions.

The percentage on each of the four columns in Fig. 14 reveals that 56.97 percent of the total time is spent on pictures when appearing in the inside positions while only 43.03 percent of the total time is devoted to the same pictures when appearing on the outside positions.

Whenever any one of the four columns is changed from an outside to an inside position, the percentage of time devoted to that area is

Fig. 14AA two page spread with pictures in the two outside and inside columns.

Fig. 14B—Same pictures with inside and outside columns reversed.

a. 12.25	a. 16.92	a. 29.92	a. 18.92
b. 27.25	b. 28.29	b. 10.50	b. 9.00
c. 14.50	c. 21.75	c. 17.34	c. 21.43
d. 23.25	d. 36.00	d. 9.50	d. 6.25
e. 14.50	e. 31.46	e. 18.25	e. 10.79
f. 15.17	f. 35.09	f. 15.17	f. 9.58
g. 13.59	g. 36.59	g. 16.41	g. 8.42
h. 13.50	h. 22.09	h. 20.67	h. 18.76
Total Time on area 134.01	Total Time on area 228.17	Total Time on area 134.76	Total Time on area 103.15
% of Total Time Available 22.33	% of Total Time Available 38.02	% of Total Time Available 22.46	% of Total Time Available 17.19

Fig. 15—Four layouts in each of four positions.

increased. In cases where a column is changed from a left outside position to an inside right position the increase is small. However, when the left position preference is competing against the center position preference, will thereby cause two laws of attention to operate. Wherever an inside left competes against an outside right the difference in attention time is far greater than where an inside right competes with an outside left.

TABLE III

Relative Time Spent On Inside and Outside Positions of a Layout.

Position	Mean	S. E. m.	Mdiff.	S.E.	CR
Inside	17.09	.66			
			5.00	.91	4.56
Outside	12.09	.66			

The study of ocular patterns is significant; first because it suggests that one type of performance is preferred to another and secondly, because it raises the question of the relative influence of the physical and psychological determiners of attention.

Purpose: To discover which of four advertising layouts had the most attraction and interest for readers.

Method: Copies of each of the four layouts (Fig. 15) were mounted side by side on cards so that 8 different position-sequences resulted as follow:

Card 1. Ad 3-4-2-1	Card 5. Ad 3-4-1-2
Card 2. Ad 2-1-3-4	Card 6. Ad 1-2-3-4
Card 3. Ad 4-3-1-2	Card 7. Ad 2-1-4-3
Card 4. Ad 1-2-4-3	Card 8. Ad 4-3-2-1

Each of the eight position-sequences was seen by a different group of 5 people. Each layout appeared in each position twice and was seen by a total of 40 subjects, 20 men, 20 women. No one subject was shown any ad more than once. Each subject was allowed 15 seconds viewing

time. None was told of this time limit, and each expected unlimited time.

Results: Although this test was primarily designed to test the comparative values of the four layouts, the method used gave an equally effective check on the comparative value of the four positions. Since each layout appeared in each position twice, the chance of each position to attract and hold the reader's attention was comparable in terms of copy appeal.

However, the table in Fig. 15 discloses that regardless of the equal opportunity of each position to get reader attention, the 40 subjects (eight different groups A to H of five subjects each) spent far more time on the center left position than on any of the other positions—seven of the eight groups. One group spent more time on center right than on others.

"In terms of percentage of the total time available (600 seconds . . . 40 subjects each view for 15 seconds) the center left position was far in front, with 38.02 percent of the total available time spent on it. Center right and outside left positions secured almost the same percentage of the total time . . . center right having a slight advantage.

Indications: In a limited time, units in the center left quarter of a vertically divided layout area have the best chance of getting reader attention.

Ocular patterns are as individual as the speech or walking habits of human individuals. However, certain characteristic eye movements are common to all, and on the basis of these similarities the science of psychology arrives at sound conclusions. The discovery of these principles

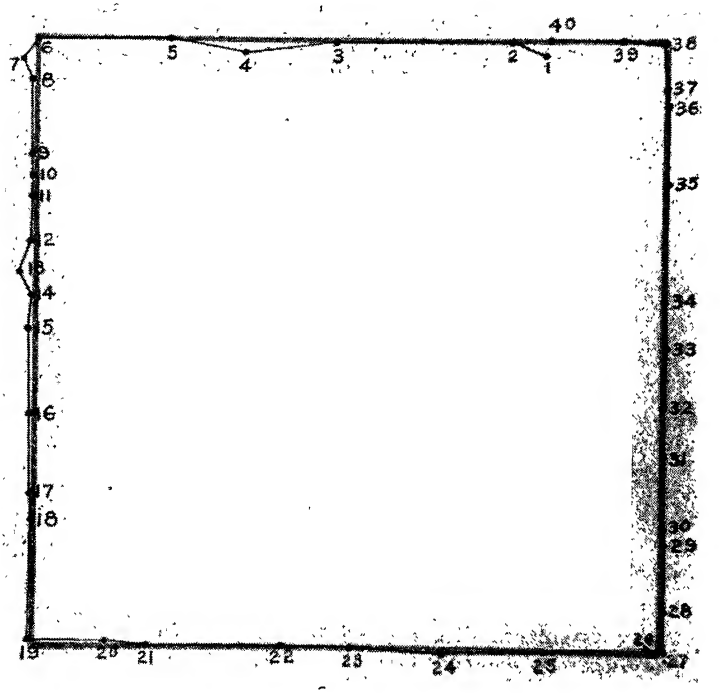


Fig. 16A—Subject traces a square with his eyes.

provides valuable information for the analysis and interpretation of human behavior.

Ocular Control: To demonstrate the control of eye movements a subject was requested to trace a square and a circle by fixating as frequently as every 10 or 15 millimeters. With but few digressions the subject traced the square and circle completely.

Position: Of all the physical variables studied in the research laboratories, position is one of the strongest physical determiners of attention. Based on research, it seems both logical and psy-

chological that an individual would look first to the left and then to the right. This tendency, as has been pointed out, is due to the physiological and psychological conditions.

Artists and advertisers or text book writers cannot overlook this principle as they proceed to make their layout. Both efficiency and satisfaction are enhanced when the natural laws of ocular performance are given due consideration.

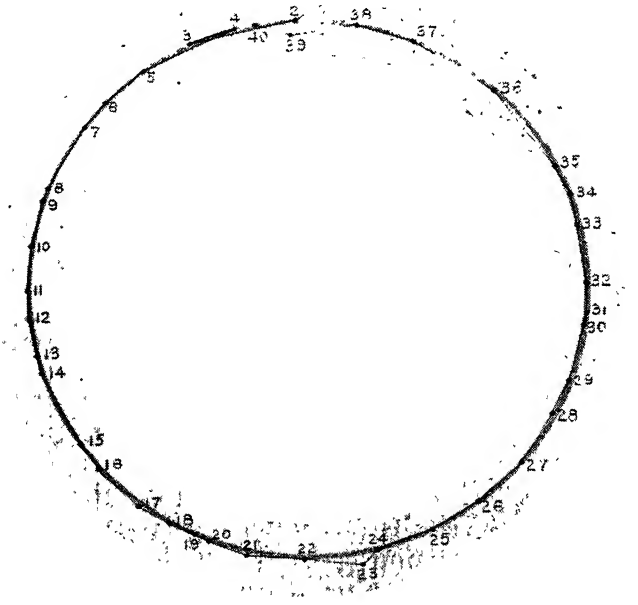


Fig. 16B—Subject traces a circle with his eyes.

Eye direction: To learn from research certain ocular tendencies is to apply the findings to practical situations. It is evident from the thou-

sands of ocular patterns recorded and analysed that the eye moves in a straight line for only short distances. This corresponds to behavior as well as conditions in the natural world. Observe, for example, a tree, a stream, or mountain. Each is irregular in its own way and at the same time fills its place in the scheme of things.

To take advantage of this principle would be to provide the eye, whether it be in pictorial or printed copy, with materials which would not require too many eye fixations in one direction. Have you ever noticed how difficult it is to read a typewritten page with lines six to seven inches long? This is largely due to the long line which compels the eye to move in a certain direction long after the natural forces at work have called for a change.

Among the most outstanding characteristics of the ocular patterns were the frequency and location of fixations as well as direction and distance of excursions. Frequency and duration of fixations constitute measures of protensity, while excursion distance and direction imply extensity. Both are a type of dimension which may be measured with laboratory instruments. From the analysis of the ocular patterns it is apparent that factors other than variables in the content are responsible for certain modes of behavior.

Research has revealed that excessively short lines (four to five words) and excessively long lines (twenty to twenty-five words) are both read much more slowly than lines of moderate length, (of eight or ten words).

Decreased efficiency in reading short lines is believed to be due to the difficulty in making

use of peripheral vision in the horizontal direction. This provides little opportunity for increasing the perception span. The long line on the other hand involves an excessive number of fixations in sueession, and as a result many more regressions are made. This is attributed to the difficulty in swinging back to the beginning of successive lines. The moderate length of a line nine or ten words, has been found to be most satisfactory.

Vertical vs. the horizontal eye movements has a definite bearing upon how advertisements are observed and how headlines are read in advertising. This principle of verticle vs. horizontal eye movements has also a very definite effect on how printed copy is read. When printed or pictorial matter is presented to the learner, whether on the black board or in text books, information is more readily assembled, organized, and assimilated when the eye has an opportunity to move horizontally. To require the subject to make an excess number of eye movements vertically places greater demands on the physical and nervous energy and introduces a type of annoyance which is minimized when eyes move horizontally.

This same principle should be observed when creating an art production. If aesthetic experience depends to a degree on ocular performance, it is altogether likely that certain pictures rerequire too many vertical eye movements to give the satisfaction which should rightly accompany ocular activity when observing a picture or an art object.

Industry cannot afford to overlook this principle of ocular performance since time and mo-

tion play a larger role in all of the activities necessary for effcient workmanship. Fatigue and accidents are likely to be reduced when paying due respect to the laws of ocular performance.

Photographic eye a myth: Consciousness is not uniform. Its center is relatively clear while the margin is indefinite and vague, and the more intensely the center of a given field is focused, the more sketchy and obscure will the outer fringe become. During intensive concentration, one group of impressions becomes exceedingly clear while others fall into obscurity. This process continues as an individual observes a picture or landscape until the entire field has been examined.

The concept that the human eye looking at a picture or object comprehends or sees the entire area is a myth. Only a very small area stands out at any one time, and the more vivid the center of attention the greater the obscurity of the margin. The degree of attention may actually be measured by the amount of distraction necessary to affect a change from the object of observation.

Just how much is an eyeful? This question is difficult to answer since both the type of material and the abilities of the reader determine the answer. When looking at a printed page, the average reader of college level has a span of about 1.25 words per fixation. That is, in reading a printed line of five words he would make four fixations. The best readers have a span of five or six words.

How long can we attend to a single stimulus? This question has been answered in the research laboratories where accurate measurements of the character of attention have been evaluated, and

it has been found that our attention shifts from one part of a given field to another many times every second.

When we say we can attend to a single picture or problem for as long as a minute or more, we simply say that we dwell on different phases of the same problem for a brief period of time. Ocular patterns are a clear demonstration of this characteristic of observation.

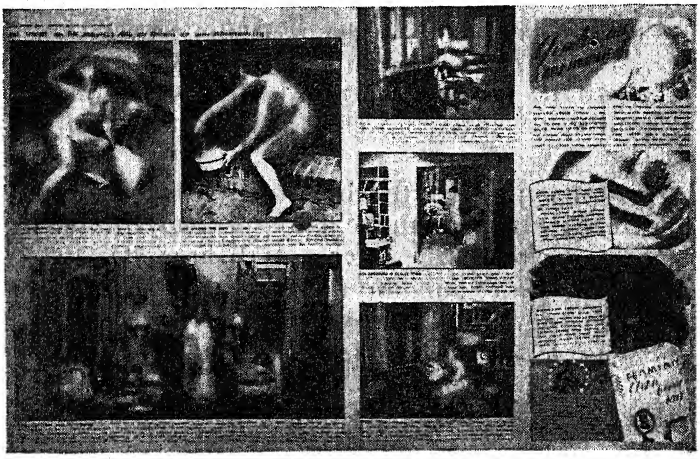


Fig. 17—A crude representation of the relative vividness of an observed field.

We can attend to only one thing at a time. This statement would seem to underestimate our abilities in this capacity, but laboratory experiments clearly indicate that only one idea can occupy the focus of attention at any given time. The vivid sensation at the focus of attention are ideations whose corresponding neural processes have been reinforced, and the dim and obscure sensations are the ones whose nervous processes have been inhibited.

Fig. 18—Attempt to see the face of the old and young lady at one and the same time.

In looking at the figure above you will experience a fluctuation and shifting of attention from the face of one to the face of the other. The reason we believe we can attend to two or more things at one time is because our attention shifts very rapidly from one part of a field to another and as a result many of our activities are habitual and require no conscious attention.

PART IV

ADVERTISING — ANALYZED BY MEANS OF OCULAR PHOTOGRAPHY

"A poor advertisement costs as much as a good one. Cost of media and production are the same for both". These are the words of Hepner as he discusses the importance of pre and post appraisals of advertisements. The recognition of this fundamental principle explains why national advertisers desire to appraise their advertisements before spending large sums of money and displaying them in newspapers and periodicals.

Many of the methods employed for measuring the effectiveness of advertising have been empirical in nature. They have included such methods as: the historical, the consumers' attitude survey, recall and recognition tests, the coupon return or inquire test, preliminary sales test, direct mail, split-run advertisements and others. All of these have contributed something to the evaluation of advertising and advertising procedures, but, at the same time, scientific measures of the effectiveness of advertising are still woefully lacking.

In spite of the fact that laboratory experiments conducted apart from concrete selling situations alone will not lead to final conclusions in advertising, the author believes that ocular photography, with its unique powers of analysis will give to the advertiser a clearer concept of the course his client is following and of the relative emphasis on certain content than could be ascertained by other methods.

The laboratory method is analytical and evaluates aspects of the whole advertisement, thus discovering the course of action. The acid test of this or any other procedure will finally be determined (if it is possible) by the degree of correlation with the actual volume of sales. Hence, it follows that the really sound advertising technique would need to discover the laws underlying the process itself.

The old maxim that it is cheaper to change advertising copy than to change human nature is still valid and is in harmony with the general slogan that the customer is always right. Advertising mediums are adequate only when they most effectively and most economically gain their desired ends. Thus, the aim of scientific advertising in all its diversified technique is the same as that of all other science, namely description, predicition and control.

PHOTOGRAPHY A SCIENTIFIC METHOD

Ocular photography as a laboratory technique aims to chart the course of the eyes when observing a specific area. This procedure is fully in harmony with the principle of giving to the advertiser the assurance that a client does or does not follow the line or sequence which the advertiser desires that he should.

If the designer of advertisements knows how to employ lines, areas, color, copy, and ideas, information may be so placed that it will lead to the main item with a minimum of effort and a maximum of satisfaction. If, however, the eye

jumps restlessly from one point to another or in too many directions, the result is lack of rhythm and, consequently, wasted energy. The eyes tend to follow lines and areas, as we shall see, rather than to jump across them. Advertisements to meet the limited range and time of attention must be simple and unitary, and to meet the fluctuation of attention they must at the same time have a certain amount of complexity.

The technique of Ocular Photography has, obviously, certain advantages both for the art designer and the advertiser. If properly employed, it can reveal what catches and holds attention and can indicate centers of interest. This is expressed in terms of the location frequency and duration of such fixations. It also shows the direction and sequence of such ocular performance; thus becoming a measure of the attention value of lines, space, size, position, color, human figures, and objects or implied motion. It serves as a measure for determining the relative precedence of headline, slogans, pictures, or text in the advertisement and determines for it the power of its carry-through effect.

However, this technique not only reveals the physical variables and their effect in gaining and sustaining attention; in addition, it divulges the secrets of the interests, purposes and desires of the observer. Even the very habits of the individual are made known when the ocular patterns are analyzed.

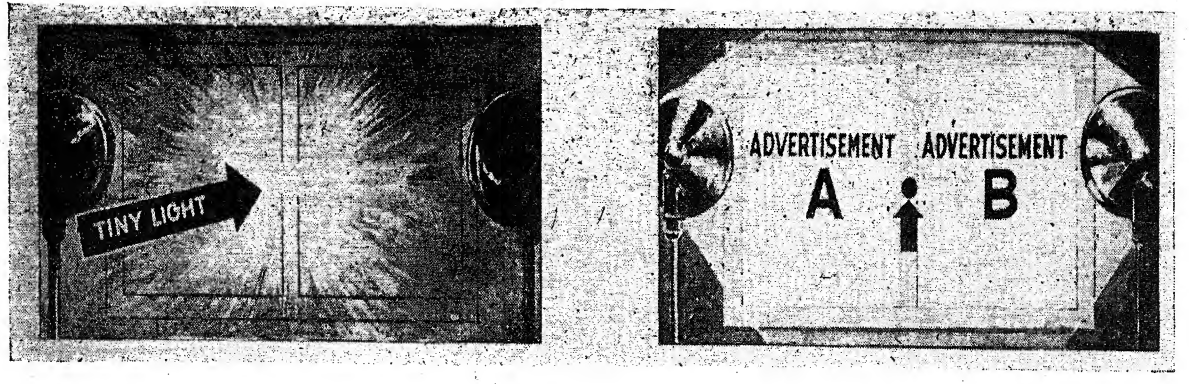
If these findings of ocular performance are practically applied, the artists, educators, advertisers, and editorial writers alike may attach a relative attention value on specific areas of the

respective determiners of attention. These principles of behavior play a significant role in the efficiency of the individual in obtaining a maximum of information or satisfaction during the process of observation.

If the tendency is for the first fixation to fall to the left and above the middle of an observed field, it would seem reasonable to lay out the advertising copy in such a way that the main idea would be placed somewhere near that point. An advertisement in which this principle has been observed will have many advantages. In the first place, the eye will not be distracted at the beginning; secondly, the direction of the eye movements can be initiated here; and thirdly, the idea introduced can have a right of way rather than be determined by the physical layout. An adequate layout, whether it be a picture or an advertisement based upon the laws of observation, must of necessity organise all physical stimuli to facilitate the main idea or purpose of the observer. To give the reader a proper orientation is an essential step in leading the reader to a satisfactory conclusion.

Then too, since the eye prefers the horizontal to the vertical movements, it is apparent that if advertising or pictorial copy which required a preponderance of vertical movements is introduced, the content will be read with very poor covereage or not at all. Head or cut line placed at the top or bottom of a layout will rarely be seen. Ilustration of this principle will be found in Fig. 39 A and B.

The left side preference reveals that a more adequate use can be made of space if the tendencies of eye preferences are known. The com-



Room is in darkness when subject is seated; subject is asked to focus eyes on tiny light on center of board where copy is to be displayed.

Side lamps are switched on for one second only; at end of one second lights switch of without warning. Eye Camera records all eye movements.

Flash preference tests should not be confused with preference tests. The former are exposed for only a fraction of a second while the latter provide sufficient time for a subject to read the advertisement and as a result indicate the relative time spent by the subject on respective areas.

While lights are turned off the copy is transposed. This eliminates chance error from any tendency of eyes to move in one direction.

Again side lamps are switched on for one second only. Each subject views same copy in all possible combinations.

Fig. 19—How flash preference tests are made.

mon purpose of ocular performance is to gain for the individual such orientation as is necessary to accomplish this purpose. This purpose is, for the most part, a desire to see more clearly and inspect more carefully the field under observation. It implies a mental process which selects or rejects and discriminates for the purpose of organizing the existing relationships. Organization from the standpoint of interpretation and permanent retention is essential and the meaning and understanding are based upon the individual's ability to organize this information in the field.

FLASH PREFERENCE TESTS.

What are flash preference tests? Two or more advertisements are exposed to a subject simultaneously, as explained in Fig. 19. The eyes of the subject unconsciously express a preference for one or the other of the two advertisements. If the same advertisement is selected by the majority of subjects under such controlled conditions, it is assumed that the advertisement selected has greater attraction power than its competitor.

It is found that a certain advertisement has the instantaneous attraction value but fails to sustain attention over a longer period. Tests to determine sustained attention should not be confused with a flash preference test where only the direction of the first eye movement is significant.

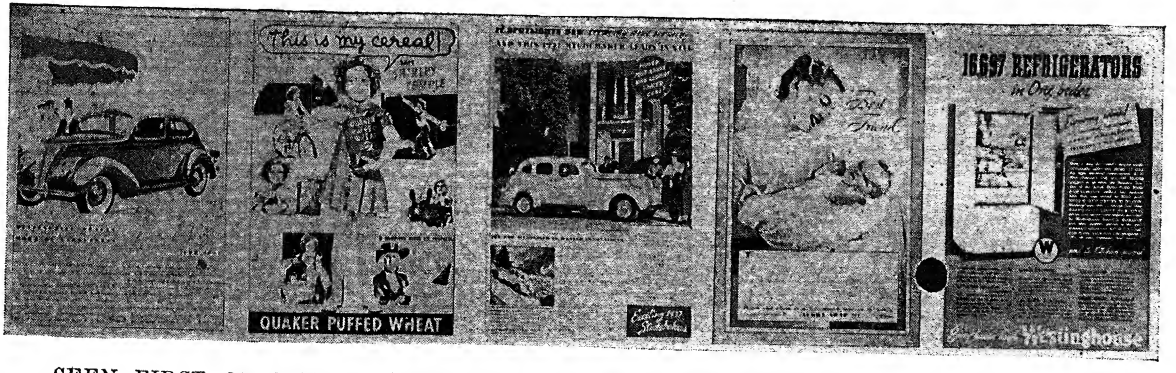
Fig. 20 and Fig. 21 A and B illustrate the flash preference test. The purpose of the test, as illustrated in Fig. 20, was to determine the relative attention value of ten different magazine advertisements.

Advertisements selected from standard magazines were exposed in pairs to twenty subjects each. Each advertisement was exposed twice, together with every other advertisement, once when appearing on the left and again when appearing on the right. Thus each advertisement was exposed eighteen times making a total of 360 combinations.

The order of preference is indicated below the illustrations for each of the ten advertisements and follows the number sequence as arranged. All five color advertisements occupy the first five places while certain black and white are a close runner up. Two top ranking black and white advertisements had nearly as many choices as two of the lowest ranking color advertisements.

Another example of a flash preference test is illustrated in Fig. 21. The purpose of this test was the same as in the preceding examination except that one of four cards in place of one out of two were selected.

Four colored car cards were mounted on a board at approximately the same distance from the subject's eyes as those displayed in a subway, street car, or elevated train car. The four cards were exposed simultaneously to twenty different subjects for a period of one second. Each subject saw the cards four times, once in each of the four positions. A tiny light, indicated by the arrow in Fig. 21, held the subject's eye fixed before the lights were flashed on. This insured no positional advantage of the eyes before the cards wer exposed.



SEEN FIRST 211 TIMES OF A POSSIBLE 360. Description: Red headline; blue awning. Other colors subdued.

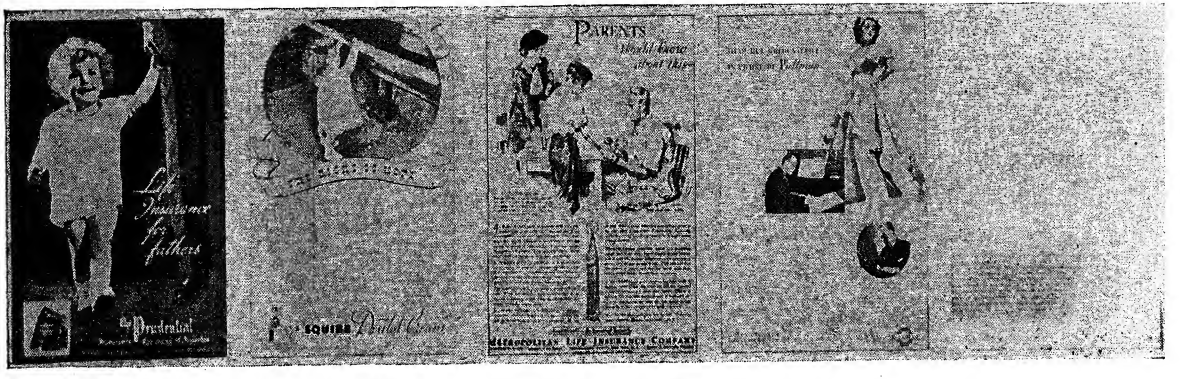
SEEN FIRST 210 TIMES OF A POSSIBLE 360. Description: Yellow headline; blue signature, blue dress.

SEEN FIRST 193 TIMES OUT OF POSSIBLE 360. Description: Yellow car, green, sig, green foliage.

SEEN FIRST 181 TIMES OUT OF POSSIBLE 360. Description: Silver and pink border, blue tint over all.

SEEN FIRST 180 TIMES OUT OF POSSIBLE 360. Description: Yellor behind head, blue behind illustration, red copy block.

While it is essential that an advertisement catch attention, for an advertisement to gain attention does not guarantee sustained attention.



SEEN FIRST 173 TIMES OUT OF POSSIBLE 360. Description: Black and white.

SEEN FIRST 151 TIMES OUT OF POSSIBLE 360. Description: Black and white.

SEEN FIRST 172 TIMES OUT OF POSSIBLE 360. Description: Black and white.

SEEN FIRST 143 TIMES OUT OF POSSIBLE 360. Description: Black and white.

SEEN FIRST 121 TIMES OUT OF POSSIBLE 360. Description: Black and White.

Fig. 20—Five colored and five black and white advertisements evaluated by the flash preference technique.

ARRANGEMENT 1:	Possible	20
	1. Girl Card	11
	2. Spear Card	5
	3. Santa Card	3
	4. Boy Card	1
ARRANGEMENT 3:	Possible	20
	1. Girl	8
	2. Santa	5
	3. Spear	4
	4. Boy	3

Fig. 21A—Four car cards with number of choices for each position.

ARRANGEMENT 2:

Possible	20
1. Spear Card	7
2. Girl Card	5
3. Santa Card	4
4. Boy Card	4

ARRANGEMENT 4:

Arrangement 2:	
Possible	20
1. Girl	9
2. Spear	7
3. Santa	3
4. Boy	1

Fig. 21B—Four car cards with number of choice of each position.

Out of the possible eighty choices, the girl, spear, Santa, and boys cards received 41.25, 28.75, 18.75, and 11.25 percent of choices respectively.

Position again plays a definite role but is offset by rotating cards so that each appears in all four positions.

SIZE AS A DETERMINER OF ATTENTION

From the analysis of ocular patterns as already ilustrated in Fig. 20 and Fig. 21, it is apparent that factors other than the physical layout alone are responsible for certain modes of behavior. However, for the purpose of analysis the writer will present such physical variables as are likely to determine the attention of the observer regardless of his interests and predisposition.

Size and attention value: Various techniques have been employed to evaluate the effectiveness of mass or size in advertising as an attention-getting device. One of these methods employs recognition and recall to determine the attensity of size while another is based upon coupons returned by those reading the copy. The recall or recognition technique simply asks that a subject read a certain periodical and later report what pictures or advertisements he remembers, or which advertising or editorial copy he recognizes as having seen before. Hence, the ratio between the size of the areas and the recall of recognition value is considered a criterion for judging the attensity of various sizes.

The coupon return technique bases its judgment of the attention value of size or mass on

the number of coupons returned for a small or large advertisement. Advertisements are keyed and the returns for each constitute a criteron for judging the attention values of relative areas or mass. Space does not permit a discussion of the merits or demerits of the methods except to present the methods of ocular Photography.

The purpose of ocular Photography is to evaluate the attensity of size by evaluating the ocular performance of the observer. The location of fixations as well as the time spent in respective areas is considered the unit of measurement and provides an objective criterion for the evaluation of variable under consideration. Two sets of exposure cards were constructed Fig. 22 and Fig. 23. On each card, the size of a full page of a standard magazine, were mounted five pictures or designs. The large picture was four times the size of the smaller one and each picture was rotated to eliminate the position variable influence.

A total of 200 college students selected at random observed the two sets of cards. One hundred looked at the design while an equal number viewed the picture of the quintuplets. (The pictures and designs were introduced to eliminate the influence of the character of the content variable.)

Each subject was instructed to observe each card as though he were reading a magazine in his home or office without a knowledge of the limited observation time.

Fig. 24 and Fig. 25 provide a clear picture of the relative time subjects spent on each of the twenty areas in the two sets of cards. Based on the statistical computation of the relative time

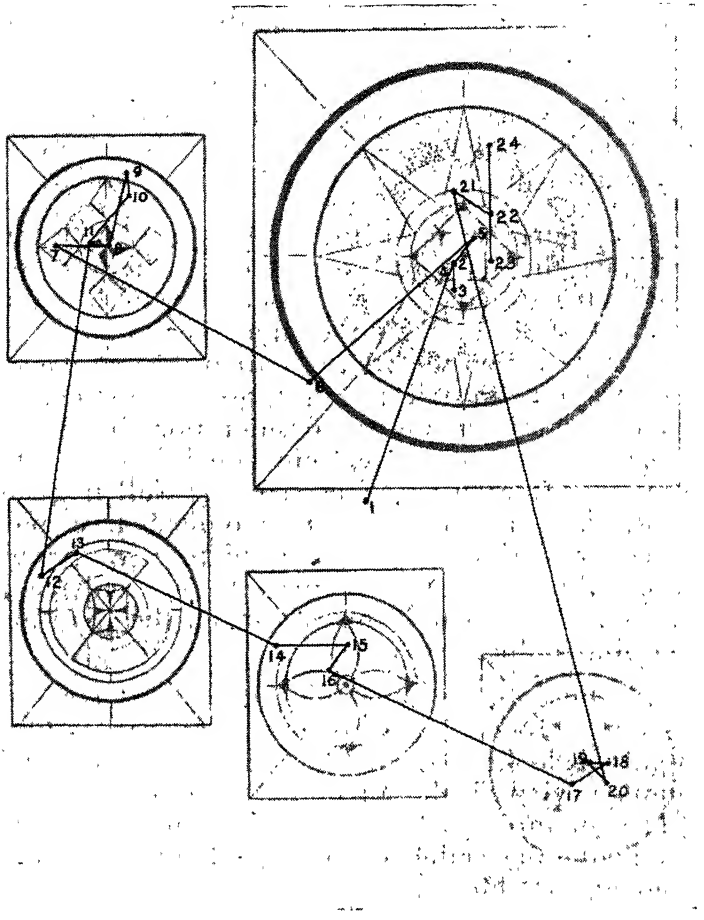


Fig. 22—Subject observing card with designs.

TABLE IV

PERCENTAGE OF TOTAL TIME SPENT IN AREAS 1, 2, 3, 4, and 5 REGARDLESS OF POSITION

Exposure Cards	Area				
	1	2	3	4	5
Designs	16.2	20.4	14.1	16.4	32.9
Pictures	14.3	19.8	15.3	17.7	31.9

spent on respective areas of the eight cards it will be seen that twice as much time is spent on the cards four times the size of the smaller ones. Approximately 17 percent of the total time was devoted by the subject to each of the small areas while 32 percent was devoted to the larger areas.

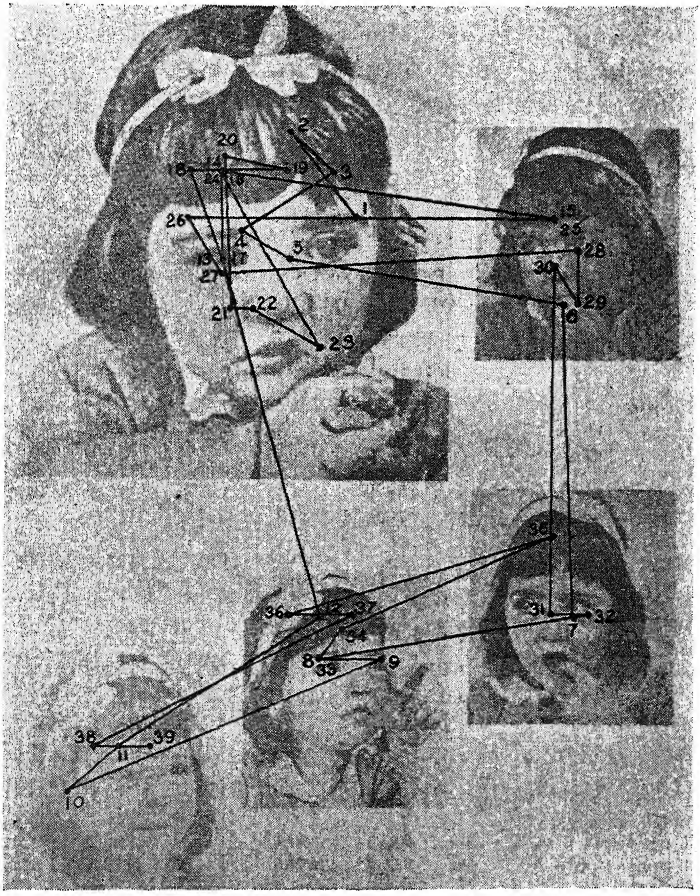


Fig.—23Subject observing card with pictures

Positions again plays an important role in determining the attensity of a given field, but regardless of position or the characters of the pictures, significantly more time is spent in the larger areas than in the small ones. Stated in statistical terminology we may say that the attention value for a given field increases to the square root of the increased area. In other words an area four times the size of another receives only twice as much attention. The results of this study are corroborated by studies of Strong and Dallenbach, who have arrived at similar conclusions by other techniques.

TABLE V

TOTAL TIME SPENT IN AREAS 1, 2, 3, 4, and 5 OF THE DESIGNS

(Time in sec.)
(See fig. 24.)

Position of large area	Area 1	2	3	4	5
Upper left	113.8	135.4	123.4	165.6	371.6
Upper right	123.1	139.4	96.7	179.8	373.6
Lower left	190.9	240.5	148.8	120.8	243.1
Lower right	176.9	203.2	154.5	143.0	234.4
Mean	151.2	179.6	130.8	152.3	305.7

TABLE VI

TOTAL TIME SPENT IN AREAS 1, 2, 3, 4, and 5 OF THE PICTURES

(Time in sec.)
(See fig. 25.)

Position of large area	Area 1	2	3	4	5
Upper left	106.3	150.1	132.9	200.2	321.6
Upper right	144.9	163.6	127.3	172.4	322.9
Lower left	154.6	197.9	153.3	130.4	264.4
Lower right	148.4	212.8	183.0	143.8	256.8
Mean	131.1	181.1	149.1	161.8	291.4

Ocular patterns resulting from the observation of areas of different sizes tell a story in terms of a type of interest evidenced by a process of selection, comparison and that which for the moment seems to be the most vivid portion of the conscious state. In any sensory experience two types of incentives operate: one, the mechanical in which case the sensory appeals such as position, size, color, or novelty of the physical field provides the sensory appeals; the other, the psychological where curiosity, interest, purpose or duty act as determiners.

TABLE VII

Mean Difference of Areas 1-4 and 5 and the Critical Ratio of Designs and Pictures.

Exposure Cards	Areas	M	S.E.	Mdiff	S.E. diff	CR
Designs	1-4	153.49	3.57	152.17	13.79	11.03
	5	305.66	13.22			
Pictures	1-4	155.74	2.94	135.69	12.18	11.01
	5	291.43	11.96			

In all cases, no doubt, there is a fusion of the influence of the sensory stimulus of the physical field and the mental content based on memories of the past and the present interpretation. Even though the attensity of a given field and cognition or reflective thinking operate simultaneously for the most part, it is likely that in the initial stages of observation the physical character or size of a given field takes precedence over the psychological interpretation. Where the reader has a definite purpose in mind before observation, the attensity of the physical field no doubt would be reduced considerably.

The psychological reasons lying back of the

increased attention values of increased areas is explained by the larger number of nerve fibers stimulated. An increased number of nerve fibers

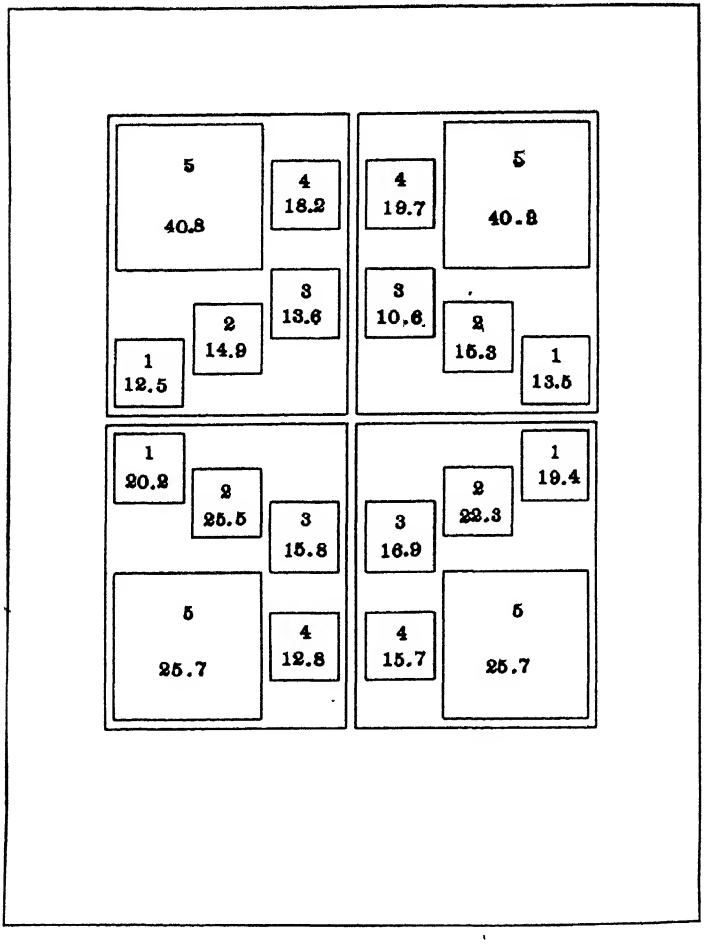


Fig. 24—Percentage of total time spent on respective designs.

increases the intensity of the stimuli and consequently releases greater nerve energy which in turn intensifies and prolongs attentional activity.

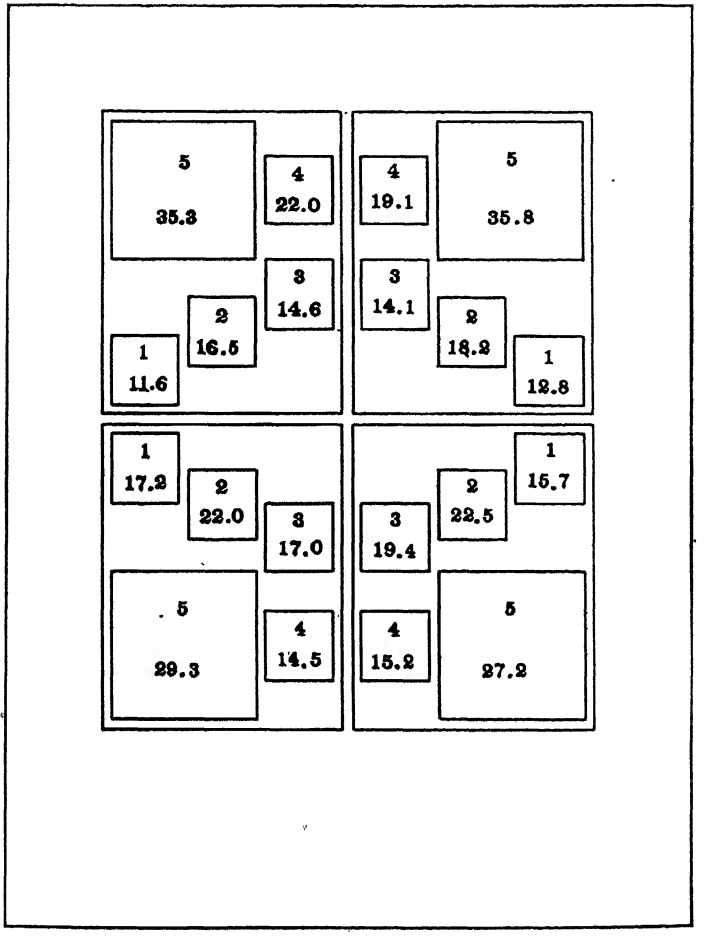


Fig. 25—Percentage of total time spent on respective pictures.

The assumption in evaluating the attensity of size by this technique is that whenever two attention provoking situations are presented simultaneously the one eliciting the long period of fixation time may be taken to possess the greater attention value. Even though the larger area has the advantage of greater magnitude, less distraction, and added prestige over the smaller areas, nevertheless, it does not increase the attracting power in proportion to the increase in its size over the smaller competitive area.

The most logical explanation for this lag in attention as related to the increase of the area is that the subject is dividing his total time between all areas not in proportion to size alone but to the respective items in the areas. As is evident in Fig. 23 the individual quintuplets, although reduced in size for the smaller area, still have two eyes, a nose, etc. This same principle holds for the design as illustrated in Fig. 22. To present the same objects or content in a miniature although affected by a reduction in size nevertheless, adds certain advantages due to the fact that it is still all there. Attention in observing smaller areas is, of necessity, focussed on smaller details and hence requires a higher degree of concentration.

The ratio of attention and size is at its best only a symbol of relationship, but it serves well as a basis for the evaluation of space as an attention factor in art and advertising. It may even determine in terms of dollars and cents the relative value for varying space areas. To know the relative effectiveness of size variables may serve as an efficient guide in cost accounting and layout construction.

It is obvious by now that certain factors essential in art production are based upon the relative effectiveness of size or mass and may be controlled by the designs if the relative attensity is known. Both an aesthetic and economic value may thus be attached to a variable physical in nature and psychological in its effect.

ISOLATION A DETERMINER OF ATTENTION

The number of research studies conducted to evaluate the attensity of isolation are few. The scarcity of scientific studies of this variable is likely due to the difficulty of treating the problem rather than to the unimportance of the influence of the variable.

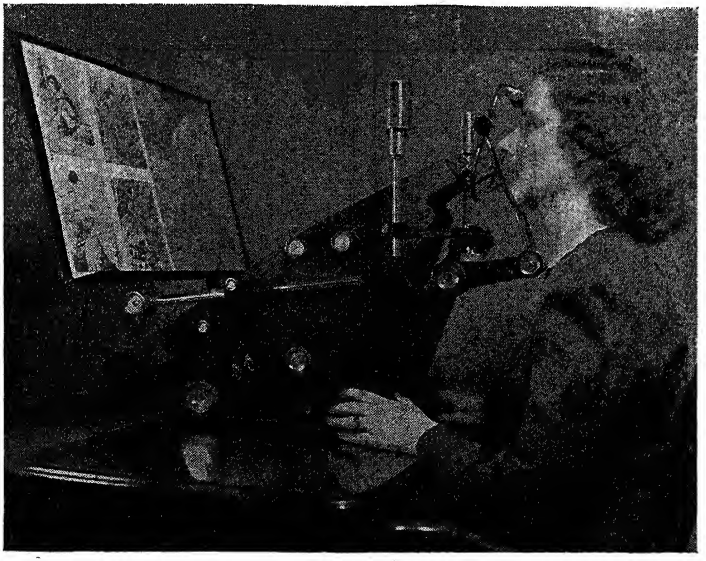


Fig. 26—Subject observing exposure card.

Isolation as a determiner of attensity has always been recognized even though the relative drawing power under varied conditions was not known. To set apart an object to be seen or an individual to be heard is considered an advantage for the object or individual so related.

To determine the relative attensity of isolation varying sizes of pictorial copy were presented to the subjects. Eight cards the size of a two page magazine spread were constructed. Four small pictures constituted the left page and one large picture known as a constant constituted the other page.

The size of the four pictures was varied for each card. The four pictures in Card A covered in equal proportion the entire left hand page leaving no white space between the adjoining

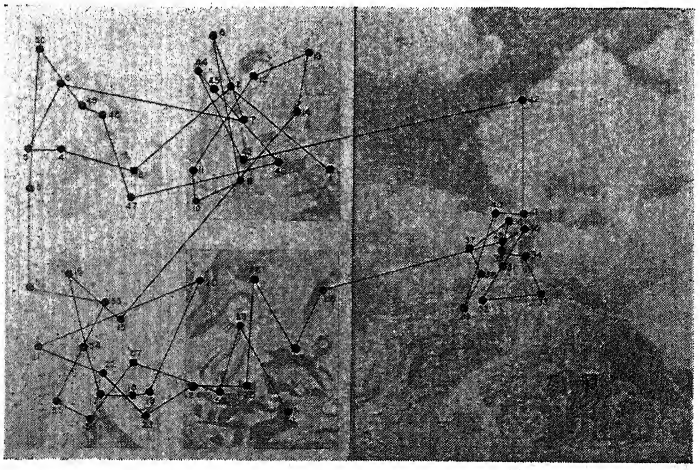


Fig. 27—Ocular pattern of subject looking at isolated areas.

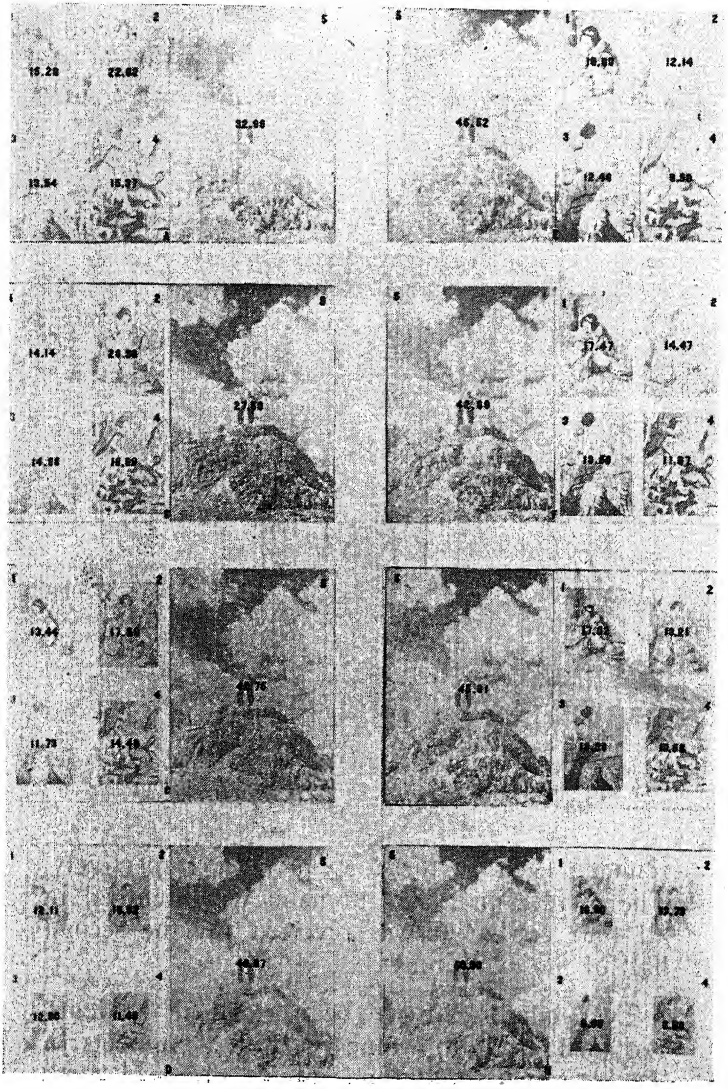


Fig. 28—Percentage of total time spent on areas of exposure card.

pictures. This is what we may call o percent isolation. Card B, C, and D were identical with Card A with the exception that 25 per cent 50 per cent, and 75 per cent of white space sur-

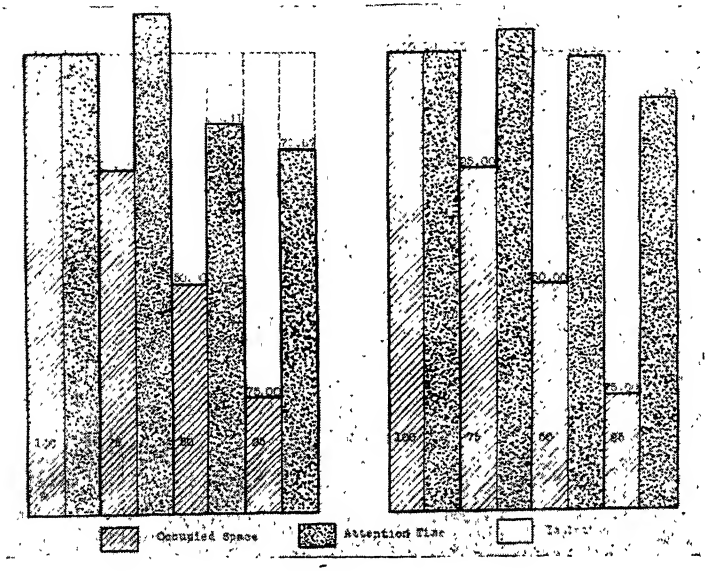


Fig. 29—A relative attention time devoted to the four areas when white space occupies 0, 25, 50, and 75 percent of the copy and appearing in the right and left hand position.

rounded each of the four pictures respectively. The picture on the right hand was identical in all four cards but was reversed for the second half of the experiment.

Two hundred forty (240) college students, 120 men and 120 women served as subjects in the investigation, but no subject observed more than one exposure card. From the illustration in Fig, 29 it is evident that an area reduced 25 per cent has the greatest attention value and that

the reduction in attention lags far behind the reduction in size.

TABLE VIII

TOTAL TIME IN SECONDS SPENT BY THE SUBJECTS IN OBSERVING THE DIFFERENT AREAS

(Thirty different persons observed each of the eight exposure cards.)

Set	Card	Isolation	Area				
			1	2	3	4	5
	A	0%	45.85	68.46	40.61	46.11	98.97
1	B	25%	42.42	79.09	44.93	50.98	82.58
	C	50%	40.34	52.75	35.18	43.48	128.25
	D	75%	36.34	50.78	38.70	34.19	139.99
	E	0%	59.67	36.40	37 38	29.97	136.58
2	F	25%	52.41	43.41	40.50	35.00	128 58

Isolation or white space has advantage within the limits of the 25 per cent area, and an advertisement with white border of about 25 per cent of the entire area has a greater possibility of being seen than when all space is filled or when the white space is reduced below 25 per cent of the field.

To gain attention when advertisements in periodicals are crowded with hundreds of items is a major problem of the editor and advertiser. Since one of the chief problems of attention is to resist distraction it is altogether possible that isolation is one solution for the problem. Starch believes that, other things being equal, isolation has both a positive and negative application. The positive phase is satisfied by making one set of features in an advertisement prominent and the negative phase is fulfilled by avoiding competition among the various devices designed to attract attention.

Five possible advantages of isolation over advertisements not so designed are that:

It may increase the attention-value of the advertisement or editorial by setting it off as in relief, giving it contrast, unity and individuality.

It may add distinction by circumscribing its physical boundaries and separate it from its competitive fields, thus providing focal attention expressed in vigor and intensity of the observed field.

Isolation as an attention-getting device seems to have a positive as well as a negative function. It fulfills the positive phase by causing the field under consideration to stand out in relief, and enhances the negative by avoiding competition of counter attractions.

White space may have the tendency to arrest the human eye and aid in the organization of the material on the page. It tends to break up the monotony of the field and consequently aid the mental process.

Based upon the figure-ground concept, a certain remoteness of the white space and a proximity of the copy seems to be inherent where white space surrounds a certain area.

Based upon the results of this research it would seems only reasonable to treat white space with a good deal of care and consideration; not that white space surround every advertisement or editorial copy but that painstaking scrutiny accompany the development of the advertising or editorial copy.

ATTENTION VALUE OF COLOR

Innumerable research studies have been made to evaluate the effectiveness of the variable of color. The general conclusion is that color has attentional advantages over black and white, and

that in order to gain attention a little color thrown in will solve the problem.

Color, it is believed, attracts attention by creating a difference or contrast to the adjoining areas or objects, but besides that it is generally conceded that color has other qualities which give it additional attention value over black and white. Color may be effective because it reproduces a product in its natural color. Colored packages and commodities generally are for that reason more readily visualized and identified. Color lends distinction and an aesthetical experience.

In spite of the added cost, color in advertisements, in direct mail, mail order, newspapers, and periodicals has increased steadily from its inception so that today a large percentage of advertisements, regardless of the media are printed in chroma.

To determine the relative attention value of color in advertisements all of the well known techniques of post publication have been employed including the direct mail test, the split run test, the prompted surveys of readership, the unprompted or unaided recall methods, and the spot testing method.

Without reviewing the findings of respective techniques, which, with but minor exceptions, have found the potency of color sufficient to offset the added cost of the advertiser, the writer submits another method of evaluation of the attensity of color.

Fifty subjects observed, while their eye movements were photographed, two advertisements, one in color and the other in black and white. Each subject observed the advertisements for fif-

teen seconds and the distribution of time between the two advertisements was recorded by the camera. The advertisements were identical with the exception of the color red.

Fig. 30—Advertisements used to determine relative attention value of red on white and black on write.

In order to eliminate the position variable the two advertisements were changed in position so that each advertisement appeared in the left and right of the editorial fifty percent of the time.

The results of the test show that red had no attentional advantage over black and white. This maybe due to the fact that subjects dislike to read print in color. Red in these advertisements had an initial attention value but failed to sustain it for more than the first two seconds.

To verify the assumption of the above test, namely, that the black print on red was responsible for the low attention value of red another

test was developed. The purpose of this tests was, again, to discover the relative attention of red, black and white.

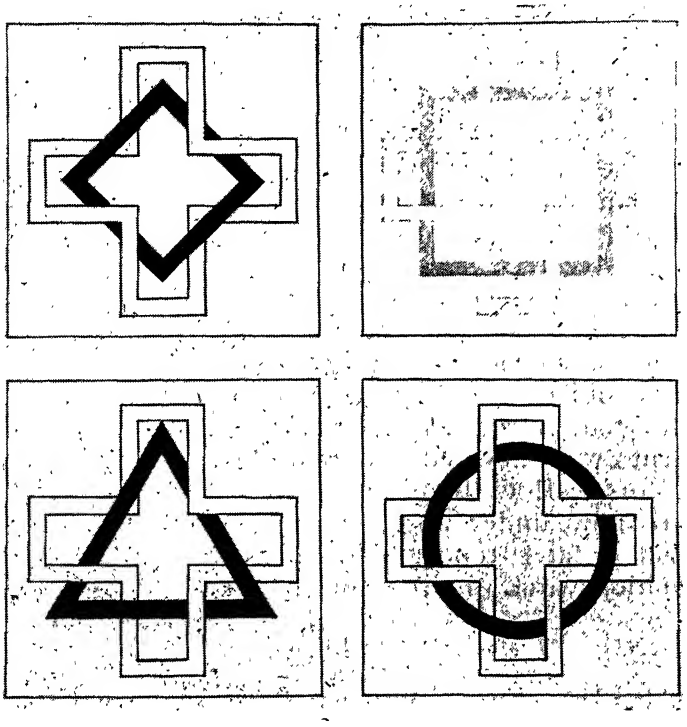


Fig. 31—A card with four designs. One in red and three in black and white.

Four designs as illustrated in Fig. 31 were mounted on four different cards. Each design appeared in red on one of these four cards and thus eliminated the position and character of the design factor. Thirty subjects observed each of the four cards, making a total of 120 subjects. Table IX below represents the relative time in

percent spent by each group of thirty subjects on each of the designs of the respective cards.

TABLE IX

RELATIVE TIME IN SECONDS DEVOTED TO EACH OF THE FOUR DESIGNS WHEN IN BLACK ON WHITE OR WHEN IN RED ON WHITE

Red on White		Black on White	
92.84	101.54	83.58	77.19
83.72	72.56	66.23	56.11

The above table indicates that red, when appearing in any of the four positions and competing against black and white in the same position, receives significantly more attention than black and white.

Based upon 100 per cent of the total time devoted to the four designs on the four cards by 120 subjects, 55.33 percent of the total time was devoted to red while an average of 44.57 percent was devoted to black on white. Other colors, yellow, blue, and a combination of colors are now under observation in the laboratories, and a later report will reveal the relative attention value of different chroma.

TABLE X

RED VERSUS BLACK AND WHITE IN ATTENTION TIME

Color	Mean	S.E.	CR	Mdiff	S.E. diff
Red and white	2.92	.11			
			.57	.11	5.18
Black and white	2.35	.04			

Red as revealed by this second test has an attensity which exceeds that of black and white when employed in proportion of 1:3. What results might have been obtained if the ratio of red and black had been 2:2 or 3:2, is not known from results of this experiment.

Regardless of chroma or the character of the design more time was spent on areas appearing on the left and upper half of the field, than on areas located on the right and lower half of the page.

No significant sex differences were revealed in this study, when comparing the relative time spent by male and female subjects on the red and black and white respectively.

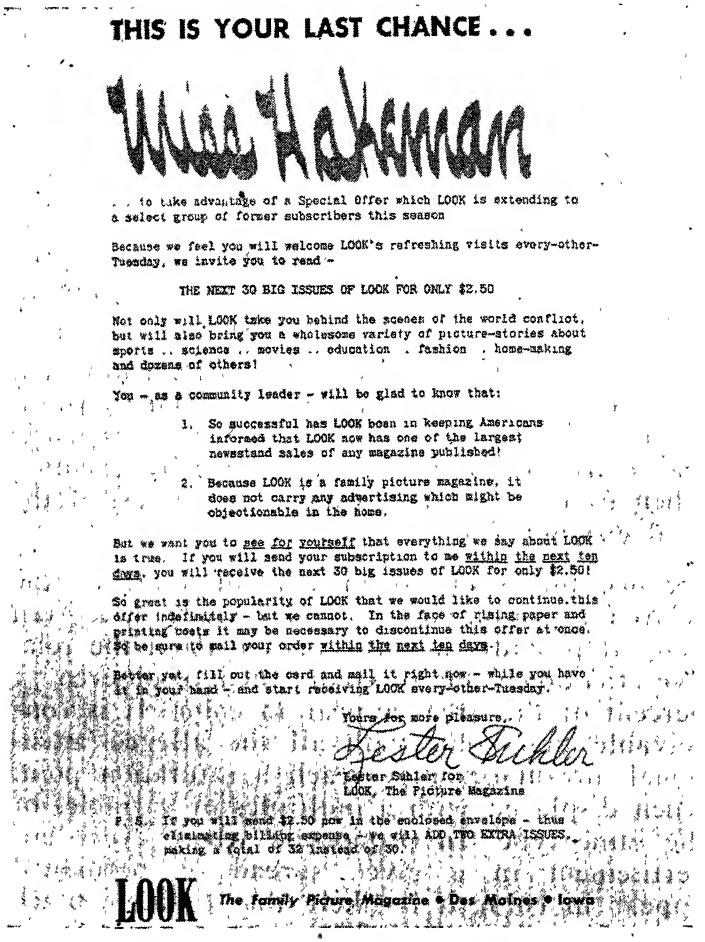
Implications: The results of the study indicate that color (red) may have attentional advantages over black and white providing other observational factors receive due consideration. It is likely that the way color is employed rather than the amount or kind used is the determining factor accompanying its effectiveness.

If color is effective only to the extent to which it creates a difference between itself and its neighboring area, chances are that both the chromatic and achromatic areas will receive more attention when using color than would be the case if the field was uniformly black and white.

Since this study is mainly interested in the relative attention value of color (red) in a given field, it provides no information about the relative attention value of color when 50 or even 75 percent of the areas appear in color. It is conceivable that color with all the alleged attentional advantages may reach a saturation point when displayed with a multiples of variables of the same type. In proportion where every advertisement in a given spread or periodical appear in color it is likely that a single black and white display would be superior in attentional advantages.

COLOR IN HEADLINES

To determine the relative attention value of red and blue in a personalized letter the follow-



THIS IS YOUR LAST CHANCE . . .

Miss Hakaman

. . to take advantage of a Special Offer which LOOK is extending to a select group of former subscribers this season

Because we feel you will welcome LOOK's refreshing visits every-other-Tuesday, we invite you to read -

THE NEXT 30 BIG ISSUES OF LOOK FOR ONLY $2.50

Not only will LOOK take you behind the scenes of the world conflict, but will also bring you a wholesome variety of picture-stories about sports .. science .. movies .. education . fashion . home-making and dozens of others!

You - as a community leader - will be glad to know that:

1. So successful has LOOK been in keeping Americans informed that LOOK now has one of the largest newsstand sales of any magazine published!

2. Because LOOK is a family picture magazine, it does not carry any advertising which might be objectionable in the home.

But we want you to see for yourself that everything we say about LOOK is true. If you will send your subscription to me within the next ten days, you will receive the next 30 big issues of LOOK for only $2.50!

So great is the popularity of LOOK that we would like to continue this offer indefinitely - but we cannot. In the face of rising paper and printing costs it may be necessary to discontinue this offer at once. So be sure to mail your order within the next ten days.

Better yet, fill out the card and mail it right now - while you have it in your hand - and start receiving LOOK every-other-Tuesday.

Yours for more pleasure,

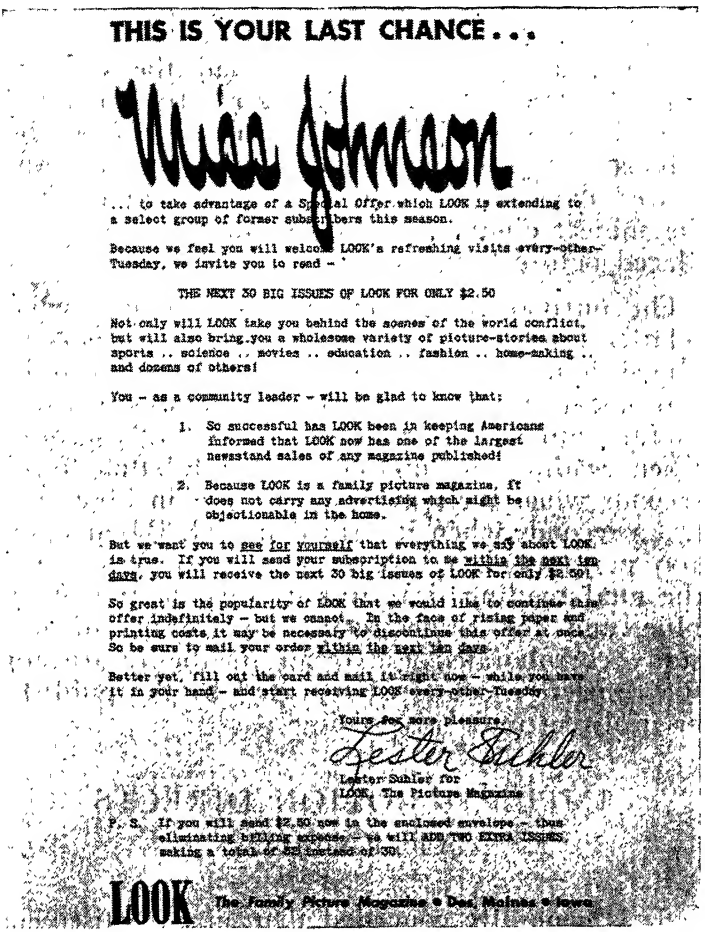
Lester Sahler

Lester Sahler for
LOOK, The Picture Magazine

P. S. - If you will send $2.50 now in the enclosed envelope - thus eliminating billing expense - we will ADD TWO EXTRA ISSUES, making a total of 32 instead of 30.

LOOK The Family Picture Magazine • Des Moines • Iowa

Fig. 32A—Personalized letter in red.



THIS IS YOUR LAST CHANCE . . .

Miss Johnson

. . . to take advantage of a Special Offer which LOOK is extending to a select group of former subscribers this season.

Because we feel you will welcome LOOK's refreshing visits every-other-Tuesday, we invite you to read -

THE NEXT 30 BIG ISSUES OF LOOK FOR ONLY $2.50

Not only will LOOK take you behind the scenes of the world conflict, but will also bring you a wholesome variety of picture-stories about sports .. science .. movies .. education .. fashion .. home-making .. and dozens of others!

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But we want you to see for YOURSELF that everything we say about LOOK is true. If you will send your subscription to me within the next ten days, you will receive the next 30 big issues of LOOK for only $2.50!

So great is the popularity of LOOK that we would like to continue this offer indefinitely - but we cannot. In the face of rising paper and printing costs it may be necessary to discontinue this offer at once. So be sure to mail your order within the next ten days.

Better yet, fill out the card and mail it right now - while you have it in your hand - and start receiving LOOK every-other-Tuesday.

Yours for more pleasure,

Lester Suhler

Lester Suhler for
LOOK, The Picture Magazine

P. S. If you will send $2.50 now in the enclosed envelope - thus eliminating billing expense - we will ADD TWO EXTRA ISSUES, making a total of 32 instead of 30.

LOOK The Family Picture Magazine • Des Moines • Iowa

Fig. 32B—Personalized letter in blue.

ing procedure was followed: seventy five women were chosen at random to observe a number of different advertisements, while their eye movements were photographed. Among the adver-

tisements was a letter soliciting the subscription of a reader. Twenty-five of these letters were not personalized, twenty five had the subjects name written in red while twenty-five had the subjects name written in blue. The name of the subject had been learned in advance and appeared in a space at the top of the letter when the subject observed the different advertisements placed before him.

The purpose of the test was to discover what relative attensity a personalized and non-personalized letter in red and blue had in terms of time spent in reading the letter. The test revealed that the subjects spent an average of 24.84 seconds when reading the non-personalized letter, 42.16 seconds when their names appeared in blue, and 47.42 seconds when inscribed in red. Based upon 100 percent 21.71, 36.85, and 41.44 percent of the total reading time was devoted to the plain, blue, and red respectively. The results of this study corroborated the order of the return for the respective colors as reported by the publisher in direct mail advertising.

IMPLIED MOTION DIRECTS ATTENTION

It is generally conceded that an advertisement should have layout and content of the type that will focus attention on the product as well as provide entertainment and information. In order to illustrate eye directions and attention value as determined by the layout an advertisement illustrated in Fig. 33 was selected. The editorial on the right page of the double spread was used as a constant and remained the same in both tests.

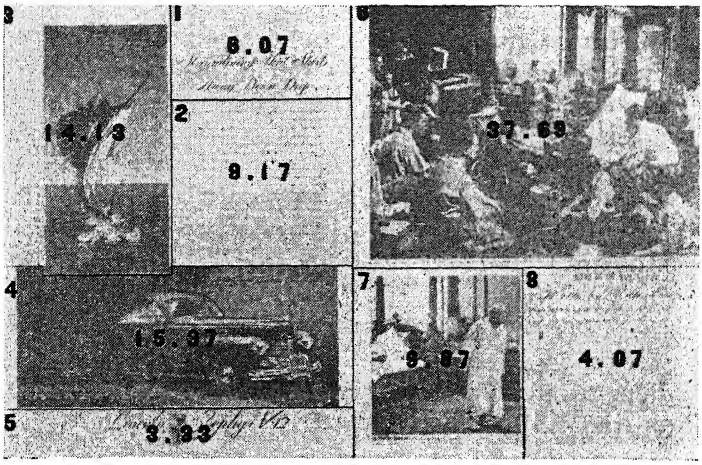


Fig. 33—Percentage of time devoted to respective areas of an advertisement.

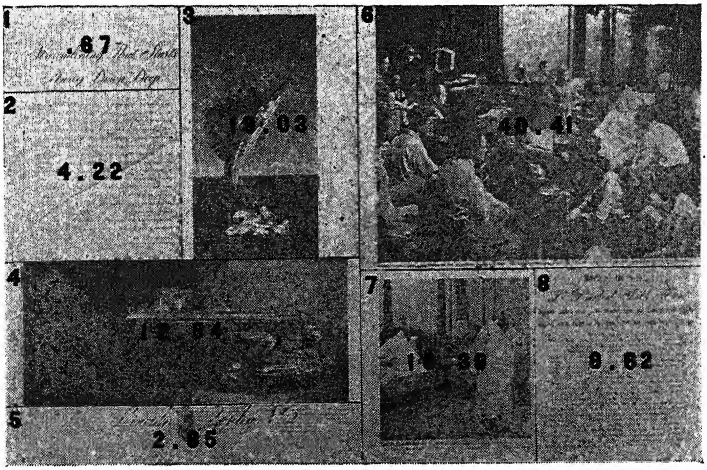


Fig. 34—Identical advertisement as Fig. 33 with position of illustration changed showing percentage of time devoted to respective areas.

Thirty subjects looked at advertisement as illustrated in Fig. 33 and thirty observed the same advertisement with the position of the picture of the fish in motion changed.

Based on the results of this study, it is apparent that the implied motion of the fish definitely affects the direction of the eyes resulting in a greater proportion of time devoted to both the copy and the editorial on the right. Since both the position and the character of the illustration are involved, the relative attensity of the two variables is difficult to ascertain for the advertisement alone, but by calculating the increased attention time devoted to the editorial this distinction is obviated.

ARRANGEMENT OF LAYOUT

Fig. 35—Advertisement A—Copy at top of page.

The purpose of this test was to judge the attention value of an advertisement when the illustration and questions were interchanged with

Fig. 36—Advertisement—B—Illustration at top of page.

the top and center positions of the spread. Also evaluated by this test was the attention value of the product and signature line when placed in either the left or right hand position of the page.

In order to determine the attention value of these two advertisements, fifty college women were selected at random and tested; twenty-five observed Card A and twenty-five observed Card B. The time was unlimited allowing the subject to read the spread as if reading a magazine in his or her own home. Figs. 35 and 36 show the two arrangements of the advertisements.

The results in this experiment reveal that the questions and copy both receive more attention time when the illustration is placed in the top

position of the spread. In the arrangements as shown on Card A only 21.40 percent of the total time is devoted to the questions and 5.62 percent of the total time is devoted to the copy and signature line. When the advertisement is re-arranged as in Card B, 24.37, percent of the total time is spent on the questions and 9.91 percent on the copy and signature line. This increase in time spent on the copy and signature line may be due not only to the shifting of the questions and illustration but also to the fact that the signature line is placed in the left hand position.

Also discovered by means of this method of evaluating advertising copy is the fact that when the illustration is placed at the top of the spread, a larger percentage of the total time is spent on the entire advertisement than on the constant. In Card A only 45.30 per cent of the total time is spent on the Ipana advertisement and 54.70 per cent on the constant while in Card B 47.89 per cent of the total time is devoted to the Ipana advertisement and only 52.11 per cent to the constant. The advertisement on the left serves as a constant against which this advertisement competes.

This experiment supports the psychological principle that the eye is inhibited when moving in a vertical upward direction. The illustration, as a rule, serves as the attention catching device of the advertisement, but once the eyes are drawn to it they tend to move downward thereby missing the questions placed at the top of the spread. The illustration in any advertisement is expected to catch the attention of the reader; but if by so doing it decreases materially the readership of the copy, it may fail to fulfill its real purpose

Editors and advertisers, alike, do well in evaluating this psychological principle implied when building their advertisement for public consumption.

ILLUSTRATIONS

Whether or not an advertiser uses an illustration as a part of his advertisement may make a marked difference in the effectiveness of his layout. Innumerable research studies have supported the notion that illustrations have attentional advantages over copy. The only question remaining seems to be what kind of an illustration shall be used.

Ocular photography has revealed beyond a doubt that pictures and figures have an exceedingly high attention value. Reading copy is only a last resort in many cases, and if the illustration is sufficiently interesting, the copy will be read more thoroughly. Just what relative time should be devoted to the illustration and copy can not be determined due to the length of importance of the copy variation.

If the illustration distracts from the copy or occupies the reader's mind to the extent where he fails to see the relation between the illustration and the product advertised, it is altogether possible that such a layout is too good for the good of the product.

To test the relative attention value of two illustrations, although not comparable except in size, fifty subjects were asked to observe two advertisements. One group of twenty-five looked at Fig. 37 and another group of twenty-five observed

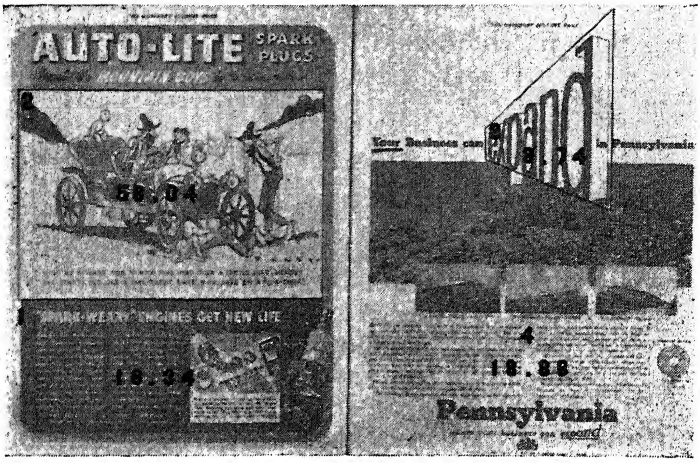


Fig. 37—Relative time in percent devoted to respective areas of a double spread.

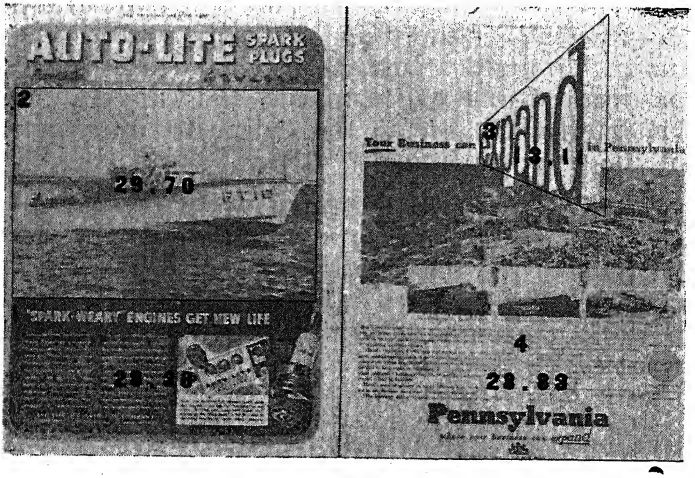


Fig. 38—All areas are the same a sin Fig. 37 except area two.

Fig. 38. The advertisement on the right hand page was employed as a constant and was not varied in area layout. The observation time was fifteen seconds.

The results indicate that subjects spent 56.04 per cent of the total time on the cartoon illustration while the boat received only 29.70 per cent with a c.r. of 6.01.

Hepner says that an illustration should not only be relevant but also free from technical errors, such as milking a cow from the wrong side or smoke going in the wrong direction on a battle ship. By means of ocular photography the effect of the novelty or the appropriateness of photographs may be evaluated.

THE HEADLINE

The figure below indicates the number of women who saw the respective areas of two layouts. Eighteen women acted as subjects. Two looked at the advertisement with the headline at the top and nine at the advertisement with he headline at or near the center.

As would be expected eight out of the nine subjects saw the headline when placed near the center, while only two read it when placed at the top of the advertisement. The result was a greater attention value for the advertisement which carried the center headline.

SEEN FIRST 12 times of possible 18.

Fig. 39A—Relative number of subjects seeing headline when near the center of the page.

SEEN FIRST 6 times of possible 18.

Fig. 39B.—Relative number of subjects seeing headline when at the top.

IDEAS

Fig. 40—Subjects spent an average of 8.98 seconds looking at hats on this spread.

Fig. 41—Subject spent an average of 10.37 seconds looking at hats on this spread.

It is generally conceded that ideas are stronger determiners of attention than the forces of the physical layout. A person who is on his way to meet his sweetheart will have only minor distractions on his way. This principle operates likewise in advertising, art, or learning. For an advertisement to catch the interest and curiosity of the reader is to cut across many of the otherwise strong physical determiners of attention. An example of the effect of this type of attention is illustrated in Fig. 40 and 41.

The insertion of the few words, "Pick your hat," as illustrated in Fig. 41, had a decided effect on the reading time of the entire group.

INTERESTS AND SEX REFERENCES

Numerous techniques have been employed and tests devised for the purpose of measuring interest and interest values. Subjective measures open to the usual errors of personal judgment, prejudice and observation are those requiring an oral response. When individuals are questioned about their interest or preferences they may not know them accurately or be inclined to answer according to what is expected. Testing interests is for the above reason often cumbersome and unreliable. In addition to the limitations stated above, individuals, when required to make a verbal or written response, often become self conscious and, as a result, emotions block their decisions.

Interest in an advertisement may not always be interest in the product advertised Few men, even thought they do not smoke could fail to have some interest in contemporary cigarette

advertisements. The illustrations and the excellent artistry of many of these advertisements could be of interest to them from an artistic or an economic point of view.

Based on the laws of attention the advertiser realizes that it is essential that he make his advertisement interesting. Even though this interest in the product may be secondary in the initial stages of observation, it may serve as a means of getting the reader's attention and finally lead to the importance of the product itself. So long as the cause of the interest is not antagonistic to the purchase of goods, it may contribute to influencing the buyer in making the purchase of the product advertised.

The tests of attention generally deal with the physical factors as determiners. In addition, however, the psychologist as well as the educator, artist, or advertiser is interested in the attention value of the psychological factors determined by the interest, curiosity, or purpose of the observer.

INTEREST IN THE OTHER SEX

A test to determine sex preference was designed by mounting pictures of men and women on an exposure card. An equal number of men (25) and women (25) were requested to look at a group of pictures as long as they desired.

Fig. 14 originally designed to determine the relative attention value of center and outside positions, was employed to determine the relative time men and women devote to looking at their own and the opposite sex.

Data based on research of this problem reveal that men spend 56.95 percent of the total time looking at women and 43.05 percent looking at men, with a C. R. of 3.18. Women, based on the results of the same study, spend 47.51 percent of the total time looking at men and 52.49 percent looking at women with a C. R. of 1.18. Men, according to this study, spend significantly more time observing pictures of the opposite sex while women spend approximately an equal amount of time on the two sexes.

Interests are significant as indicators of aptitudes and capacities which lie back of them. But aside from the biological foundations upon which abilities depend, many interests are the result of personal experience and formal training. Men, although interested in many of the possessions and activities of the fairer sex, nevertheless, evidence preferences for their own as do women. This is, no doubt, due to their respective needs and obligations and is a result of the requirements of the two sexes as expressed in their wants and desires. It is altogether likely that in time to come when men and women will participate in essentially the same activities they will be more alike than they are at the present time. During times of emergencies, when women replace men in regular duties, these differences are greatly minimized.

INTEREST AS A DETERMINER OF PREFERENCE

In order to test preferences due to interest in merchandise, seventy-five men and seventy-five

women were requested to observe two pages of a mail order catalog, one page being composed of commodities used by women and the other page containing merchandise worn by men. The relative time devoted to each page was again recorded with the eye movement camera, with results as indicated in Fig. 42, 43, and 44 and Tables xi, xii, and xiii.

Fig. 42—Relative time in percent spent by male and female on commodities worn by men and women respectively.

TABLE XI

RELATIVE TIME SPENT BY MEN OBSERVING MEN'S AND WOMEN'S SHOES

	M	SE	M diff	SE diff	CR
Men's shoes	9.50	.67			
			4.00	.93	4.30
Women's shoes	5.50	.07			

Based on the results as indicated in Fig. 42, men spent significantly more time on articles

related to their needs while women spent more time on articles of interest to them. When comparing the percentage of time men spend on women's supplies and the time women spend on the men s supplies, it is apparent that women spend relatively more time on articles of masculine interests than men do on articles generally used by women. This difference is likely due to the fact that women purchase more than eighty percent of all household supplies.

TABLE XII

RELATIVE TIME SPENT BY WOMEN OBERVING MEN'S AND WOMEN'S SHOES

	M	SE	Mdiff	SE diff	CR
Men's Shoes	7.39	.69			
			.22	.95	.23
Women's Shoes	7.61	.69			

100 college students (50 men and 50 women) were selected at random and permitted to observe a two page spread from a mail order catalog. One page comprised objects (cosmetics) such as would be likely to interest women and the contents of the other page consisted of supplies such as would be likely to interest men. In order to eliminate the position variable the pages were reversed for the two parts of the experiment. Each subject observed only one exposure card for a period of 15 seconds. Subjects were not informed of a time limit.

Fig. 43 indicates that the male subject spent 64.20 percent on items of their interest as compared to 35.80 percent on items of female interest, while women spent 60.53 percent on items of their choice in preference to 39.47 percent on items of male selection. Again the male interest difference is more pronounced than that of the female.

Fig. 43—Relative time in percent spent on respective areas by men and women when observing the above exposure cards.

TABLES XIII

RELATIVE TIME SPENT BY MALE AND FEMALE SUBJECTS ON AREAS OF THEIR RESPECTIVE INTERESTS

Sex	Area	M	SE	Mdif	SEdiff	CR
Male	Cosmetics	5.63	.60	3.74	.84	4.45
	Shaving	9.37	.60			
Female	Cosmetics	8.98	.61	2.96	.85	3.48
	Shaving	6.02	.61			

A third test was administered to 150 business men and women. Seventy five men and seventy-five women observed pictorial copy, one page being composed of such objects as would be likely to interest women or men, respectively. The relative time spent was again recorded with an eye movement camera and the relative time in percent is indicated in the figure below.

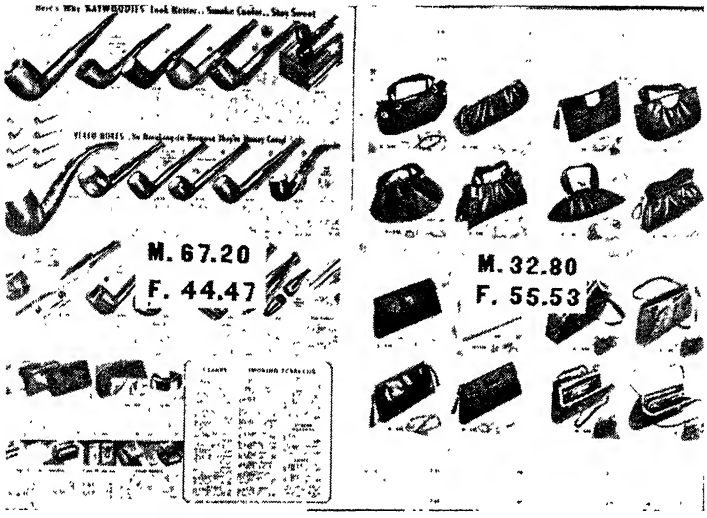


Fig. 44—Relative time devoted by male and female observing pipes and purses.

The results of the test reveal that men spent 67.20 percent of their time on pipes and only 32.80 percent looking at purses, while women devoted 44.47 percent and 55.50 percent on pipes and purses respectively.

TABLE XIV

RELATIVE TIME SPENT BY MALE AND FEMALE ON PIPES AND PURSES

Sex	Article	M	S.E.	Mdiff	S.E. diff	CR
Male	Pipes	10.08	.68	5.16	.91	5.67
	Purses	4.92	.68			
Female	Pipes	6.67	.64	1.68	.89	1.87
	Purses	8.33	.64			

In all three cases men reveal a more pronounced interest in commodities used by them-

selves and show relatively little interest in merchandise designed for the opposite sex. Women, on the other hand, reveal the more heterogenius interest. This may be due to the fact that women purchase eighty percent of the dry goods, seventy-eight percent of drug store purchases, and have a hand in selecting thirty-four percent of all men's apparel bought. In addition it is alleged that ninety percent of all food consumed is purchased by women.

Since men and women still have different interest in careers, in notions of dress and likes and dislikes, it is likely that appeals to be effective must differentiate in the kind and form of presentation.

Although psychologists believe that the difference in intellectual abilities between the sexes is slight, they nevertheless contend that non-intellectual affairs are still sufficiently pronounced to warrant a serious consideration by the salesman and advertiser.

To evaluate and announce our own interests is in most cases impractical and unsound. It may in many cases even yield preferences which are supported by rationalization or a type of justification for a choice which in reality is not truly representative of the real unconscious tendencies.

When properly employed, Ocular photography can reveal what catches and sustains attention, and can indicate centers of interest. This is expressed in terms of the location, frequency and duration of eye fixations, as well as in the direction and sequence of excursions. Ocular performance thus becomes a measure of the attention value of lines, space, size, position, color, objects or implied motion. It serves as a measure

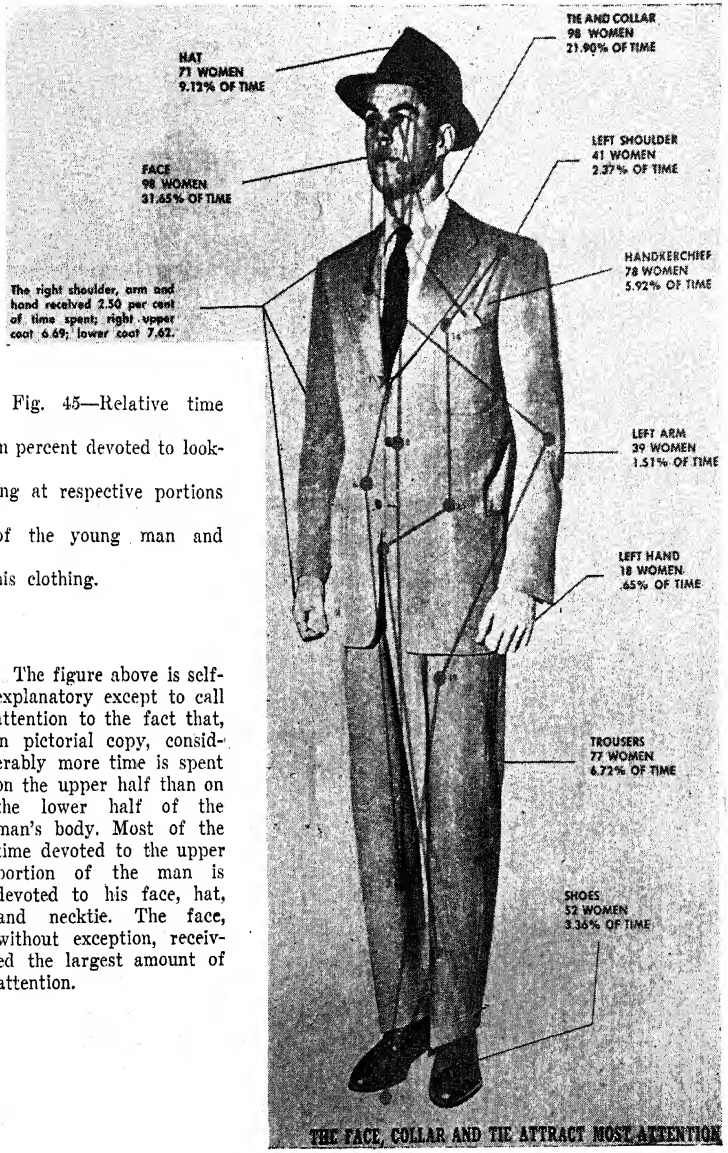


Fig. 45—Relative time in percent devoted to looking at respective portions of the young man and his clothing.

The figure above is self-explanatory except to call attention to the fact that, in pictorial copy, considerably more time is spent on the upper half than on the lower half of the man's body. Most of the time devoted to the upper portion of the man is devoted to his face, hat, and necktie. The face, without exception, received the largest amount of attention.

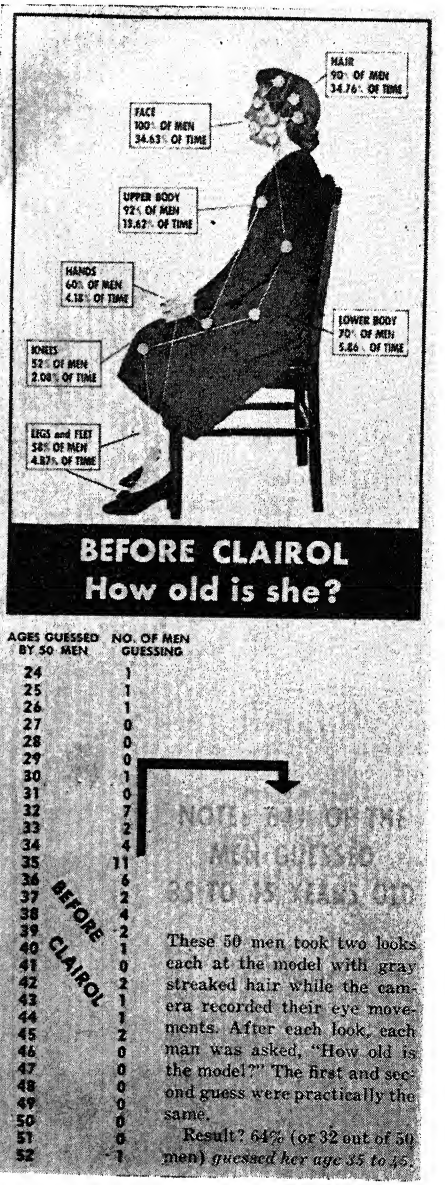


Fig. 46A—Fifty male subjects judge woman's age (prematurely gray) before hair was dyed.

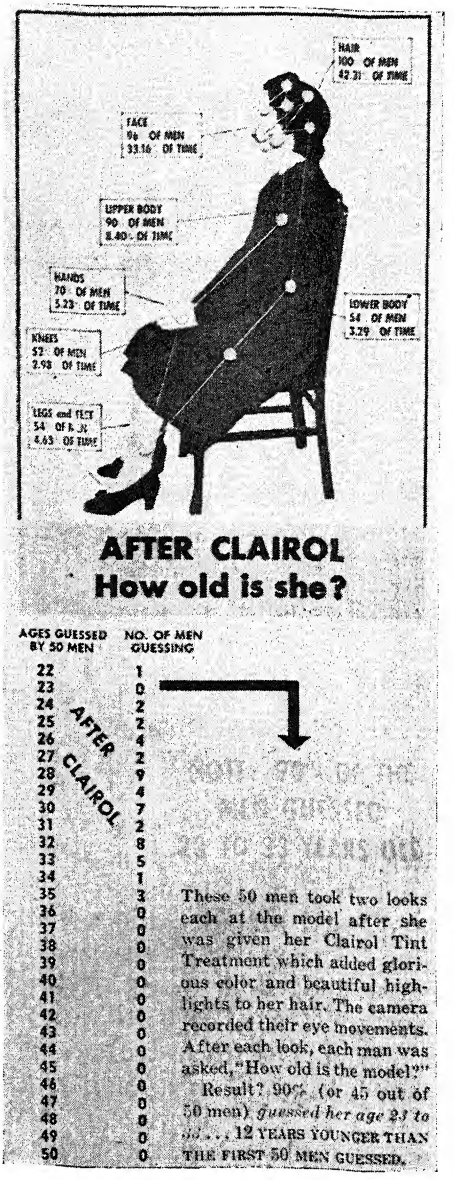


Fig. 46B—Fifty male subjects judge woman's age after hair is dyed.

for determining the relative precedence of headline, slogans, pictures, or text in the advertisement and determines for it the power of its carry-through effect.

However, this technique not only reveals the physical variables and their effect in gaining and sustaining attention in addition; it divulges the secrets of the interests, purposes, and desires of the observer. Even the habits of the individuals may be made known when ocular patterns are analyzed.

HOW WOMEN LOOK AT A MAN'S CLOTHES

Marshall Field and Company were interested in learning how women look at a man. In selling men's merchandise they were curious to know what part of a man's wardrobe is of greatest importance to the fairer sex. One hundred female subjects were selected at random to look at the young man in person as shown in Fig. 45.

HOW MEN LOOK AT A WOMAN

The purpose of this test was not so much to discover how men look at a woman as to learn what relative time was devoted to hands, hair, and face in judging her age. Fifty men were requested to judge the age of a woman prematurely gray. Fig. 46 reveals that 64 percent of men judged her age between thirty-five and forty-five years.

After fifty men had given their verdict, the lady's hair was dyed, and another fifty men were asked to judge the age. Ninety percent of these men, as shown in the figure above, judged the lady's age to be between 23 and 33 years.

Although the face as a rule received more attention than the hair, the profile view of this lady reduces the attention time for the face so that regardless of whether the hair was gray or dyed, more than one-third of the total time was devoted to looking at her hair. The very fact that the men were asked to judge her age no doubt was a determiner of the relative time spent on different portions of the figure.

ARE WE MOUTH OR EYE WATCHERS.

To obtain an answer to this query, a technicolor motion picture was prepared in which a lady's face emerged from the dark until she was

Fig. 47—Advertisement of Dr. West's tooth brush calling attention to the importance of teeth as a beauty feature.

clearly visible. Fifty men and fifty women observed this lady, and the purpose was to learn whether the observers would devote most of their time looking at her eyes or at her mouth.

The men and women observed the lady in three poses. In the first she was merely looking at them, in the second she was smiling, and in the third she was speaking.

TABLE XV

RELATIVE TIME SPENT ON MOUTH AND EYES FOR THREE DIFERENT POSES

(None of the subjects knew the purpose of the test)

	Straight Face	Speaking	Smiling
Eyes	57.63	44.15	43.93
Mouth	42.37	55.85	56.07

The picture in motion obviously produced a different situation that if the lady had been seen in a static picture and for that reason approximated a real situation. In addition, the motion picture had the advantage of saving the lady the embarrassment of looking at her spectators or vice versa; hence, the situation was more nearly normal. From Table XV it is apparent that more time was spent on eyes than on her mouth when she was merely looking, but when she began to smile and speak, significantly more time was devoted to her mouth than to her eyes.

The relation of Dr. West's tooth brush advertisement recommending proper care and cleansing of the teeth and these findings is obvious. Since in both speaking and smiling, eyes are concentrated on the mouth, the attractiveness or unattractiveness of the teeth is not likely to be overlooked.

Attention, which is essential to the whole process of learning, makes for greater discrimination and intensified thinking, and advertising appeals to these same processes. Whether we prefer it or not, we tend to ignore the unfamiliar and keep contact with the known. If interest procedes attention in familiar experience and attention precedes interest in new experience, then it follows that the type of appeal should be changed as the customer becomes educated or familiar with the product sold and with the company advertising.

The technique of ocular photography applied to a good advertisment, regardless of the stage of education of the customer, should reveal whether the observer follows the direction or sequence in direction as intended by the advertiser. It may determine the relative effect of contiguous advertisments and establish for the advertisement a relative attention-getting power over competitive or non-competitive advertisements. By this technique, age, sex, vocational, and social differences may be revealed which will determine the type of advertising most effective for certain customers.

The results as indicated in Fig. 20 and 21 represent selection as based upon attention preference. The data indicate that certain advertisements have a decided attention value which increases the probability of their being observed first. This is the first step in analyzing ocular movements as applied to advertising. Subsequent studies as determined by this technique reveal the relative amount of time spent on each advertisment, the relative amount of time devoted to each part of the layout, and the sequence of ocular movements.

This same principle operates in art and learning as well. The attention time is a valid criterion for the physical attraction of the observed field or for the interest and purpose of the learner. To be able to lay out an advertisement, paint a picture, or present subject matter in such a way that the course the subject will follow can be predetermined may be considered an art in the field of human engineering.

PART V

LEARNING—INTERPRETED WITH THE AID OF PHOTOGRAPHY

Learning is the biggest and most serious business of life. Significant differences among individuals may be attributed largely to their ability and desire to learn. Intelligence, as measured by tests; is in a way a measure of what people have learned. Although an indication of native ability it is obvious, nevertheless, that certain individuals with less native talent who apply themselves diligently may accomplish more in school, industry, and business than their superior competitors. This does not by any means imply that superior intelligence is not an asset; it is simply illustrating that the intention to learn and the willingness to apply one's self go a long way in achieving one's goal.

IMPLICATIONS OF LEARNING

Learning, as the word is commonly used, implies many phases of human behavior. The individual who learns is simply initiating new ways of doing things, making an improvement over past records, or making automatic or habitual the skill (motor and mental) already learned. In the language of a psychologist, learning is the modification of the nervous system in such a way that the adjustments necessary for common and special tasks become automatic and efficient.

Since much of what we learn frequently begins without knowledge or experience in the activity, it is often necessary that we employ the trail and error method in getting started.

Much of our knowledge is acquired that way and although it is the hard and the more crude way, nevertheless, it provides the individual with an adjustment pattern adequate for his purpose in subsequent adjustment situations. The more economical and efficient way of learning is by following directions and thus evading many of the blind alleys in which much time is spent without accomplishing much toward the desired results.

To learn is to reduce errors, increase skill, and accomplish the task with a maximum of satisfaction. It is natural for people to learn. The difference between the history of man and beast is largely due to the ability of the former to learn new ways of thinking and adjusting. Even though animals can learn, their knowledge of affairs and modes of conduct at best are exceedingly limited and inadequate in the mechanized world of today.

BASIS OF LEARNING ABILITY

The plasticity and the modifiability of the nervous system is largely responsible for our ability to learn new ways of doing things and making behavior patterns natural and automatic. Psychology calls the entire process conditioning.

Most learning follows this line of integration. The sensory mechanism, including eyes, ears, etc., transmits by means of sensory nerves, impulses to the central nervous system which in turn directs the impulses to motor organs for purposes of adjustment. Regardless of whether the adjustment is successful or not, the nervous system is changed or modified to the extent that

whenever a similar situation arises, to do or not to do will be largely predetermined by what has taken place previously.

THE PROCESS OF LEARNING

Although it is impossible to define learning so that the definition connotes all that is implied, functional discrimination seems to be one of the major evidences of learning. In the learning of content material, whether in arithmetic, geometry, chemistry, or in learning to drive a car, "learning" must consist in the construction of an organized and differentiated pattern to which a selective response can be made. Adequate or efficient learning requires, for that reason, a unique organization constructed to yield relations that are clearly perceived and adequately controlled for the purpose of completing the act. The record of the eye-movements, as the gaze follows a direct path across the content studied, makes it evident that the creation of significant data depends upon a selective process. The construction of an orderly and unified constellation out of a complex and obscure order is managed somehow by proper shifting, fixation, and inspection.

Adequate construction of the organization of content material depends, first upon the capacity of the learner; secondly upon his previous experience; and thirdly, upon the inherent and coherent organization of the material presented.

If learning is the product of perceived relations in their manifold forms, then it may be profitable for educators to inquire at what state

of relations the learner now stands. A redistribution of effort and modified presentation of the form and quantity of subject matter may constitute essential conditions in aiding the learner to control more efficiently the organization of the content studies. Learning in its basic character depends upon the fulfillment of certain temporal conditions in stimulus relationships and upon the presence of well established conditioned responses.

If the above is true, then the ability to organize becomes the criterion of the possibilities of reproduction later. The learner evidences the process of organized, perceived relations by "knowing things together," by grouping data around some central area, by causing some parts to stand out, by reading meaning into the content, and somehow causing unity to emerge. Thus, the image becomes schematic and orderly, and the relations become natural and coherent.

The superior learner naturally perceives relations with great clarity;; for him, the relations function in terms of more adequately controlled organization. This is further substantiated by experimental evidence, which points out that certain perceived relations are more easily learned and more readily recalled than others. This is an indication that relations of a certain type have a value which determines for them a predestined ratio of delayed recall.

The question of whether the eyes or the central processes are the major determiners for a certain ocular pattern is answered in part by requesting the subject in an experimental procedure to select specific data from a page of content material. The inspection given, either by the

subject or someone else, and the difference in the patterns are largely the products of the central processes of the learner. The "aufgabe" (self assigned task) is a potent influence in ocular performance. In Figs. 61 and 62 subject looks at problem with intention to study it. Ocular performance in this problem as in problem solving or learning in general, is no doubt affected by the intellectual capacities, experience and the purpose of the learner.

Ocular photography will most likely lead to a better understanding of the functional relationships of the eye as a sensory and motor organ while adjusting itself to novel situations. Such advocates of the motor theory as Munsterberg, Breese, Royce, and others would imply that consciousness depends for its existence and character upon the transference of sense stimuli into motor patterns, thus causing the incoming sense stimuli or outgoing motor enervations to become a single new process. Some would even go so far as to say that the motor discharge is necessary in order that the central activity may take place. Motor elements thus become the limits of thought, and the inhibition of movement results in the inhibition of attention. Whether we agree or disagree with the postulates above stated, the writer is of the opinion that, even if the efferent responses did not have a direct representation in consciousness, consciousness would under any circumstances be dependent upon them.

Without going into the technicality of the learning process, the writer will present in the following pages illustrations of the evaluation of the learning process by means of Ocular Photography.

Since the days of Ebbinghaus, 1885, who made one of the first real attempts to apply scientific methods to evaluate the problem of learning as related to higher mental processes, innumerable experiments have been made in this field. Based upon such findings, various theories of the learning process have been evolved and formulated, and explanations of the mechanical aspect of learning have been attempted. Each experiment was in a way an attempt to provide information for modern pedagogs to minimize teaching efforts and increase the efficiency of the learner.

PURPOSE OF THIS STUDY

The purpose of this study is to evaluate, by means of ocular photography, the indices of the learning process. Since the mind is known by behavior of some kind, it would seem logical to assume a study of the characteristic behavior of the human eye would reveal some of the mental processes involved. If attention, retention, reason and reproduction are different phases of the learning process, it is likely that the analysis of ocular patterns would provide a valuable technique to evaluate such mental content.

This study is an attempt to evaluate:

1. The relative time spent on respective symbols due to position.
2. The relative achievement for certain symbols due to position.
3. The relative excursion frequency in the vertical and horizontal plane.
4. Characteristic differences of the ocular patterns of subjects of high and low achievements.

Method and Procedure

Exposure Cards: Two cards 14 inches square were constructed with four design each. All symbols or designs were different, and each covered an area of 4 inches square. Card B was identical to Card A, except that all symbols were reversed in order of position. See Fig. 48.

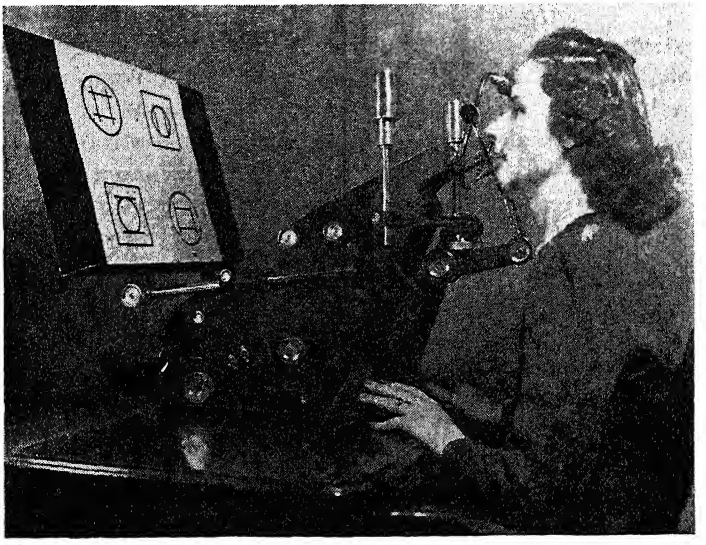


Fig. 48—A Bidimensional Eye-movement Camera and Exposure Card.

Subjects: Ninety (90) High School seniors selected at random acted as subjects for this study. Forty-five (45) subjects observed card A while forty-five (45) saw card B. Each subject was instructed to observe the card with the in-

tention to reproduce the symbols later. No student was informed of the time limit, but each card was exposed for ten seconds only. If all symbols were correctly reproduced in the proper location, the achievement was 12 units, the highest score obtainable.

Results

1. *Position and Attention Time*: This study shows that consistently more time is spent on symbols appearing in the upper left position than when appearing in the lower right area.

For purpose of illustration only symbols (1) and (4) will be treated statistically. Table xvi indicates that significantly more time is spent on symbols (1) and (4) in the upper left than when appearing in the lower right position.

TABLE XVI

Relative Total Fixation Time devoted to the Upper Left and Lower Right Hand Position for Symbols (1) and (4)

Symbol	Card	Position	M	S.E. M	diff	S.E. diff	C.R.
1	A	Upper left	3.49	.15			
					1.86	.18	10.33
1	B	Lower right	1.63	.11			
Symbol	Card	Position	M	S.E. M	diff	S.E. diff	C.R.
4	B	Upper left	3.67	.17			
					2.09	.21	9.95
4	A	Lower right	1.58	.12			

This study confirms the findings of an earlier study, namely, that position is a potent determiner of attention value.

2. *Position and Achievement*: By analyzing the ocular patterns of subjects observing the four designs, it is evident that certain positions demand a longer time than others. Just what

mental accomplishment took place during that time is illustrated in Fig. below. This tabulation indicates that the achievement in the upper left hand area is greater that in the lower right hand position.

Table XVII supports the assumption that a longer time devoted to study in certain areas (other things being equal) will yield a greater achievement. Both time and achievement are significantly greater for the two symbols when appearing in the upper right hand position. Symbol (4) with a critical ratio of 5.30 seems to profit more from the changed position than symbol (1) with a critical ratio of 3.78.

TABLE XVII

Relative Achievement for the Upper Left and Lower Right Hand Position for Symbols (1) and (4)

Symbol	Card	Position	M	S.E.	M diff	S.E. diff	C.R.
1	A	Upper left	2.38	.15	.87	.23	3.79
1	B	Lower right	1.51	.18			

Symbol	Card	Position	M	S.E.	M diff	S.E. diff	C.R.
4	B	Upper left	.87	.15	1.06	.20	5.30
4	A	Lower right	1.93	.13			

3. *Horizontal vs. Vertical Excursions*: A further query presented itself in regard to the character of the excursions of the ocular patterns resulting from the observation of the specified subject matter. Is the excursion frequency greater in the horizontal than in the vertical plane?

In tabulating every excursion of all subjects the data reveal that a total of (395) excursions from one symbol to another were horizontal movements, (204) were vertical movements and (112) were diagonal excursions.

TABLE XVIII

Horizontal vs. Vertical Excursion Frequency

Exposure	Excursion	M	S.E.	M diff	S.E. diff	C.R.
Card A	Horizontal	4.73	.30	2.69	.39	6.90
	Vertical	2.04	.26			
Exposure Card B	Excursion Horizontal	4.04	.26	1.55	.36	4.31
	Vertical	2.49	.20			

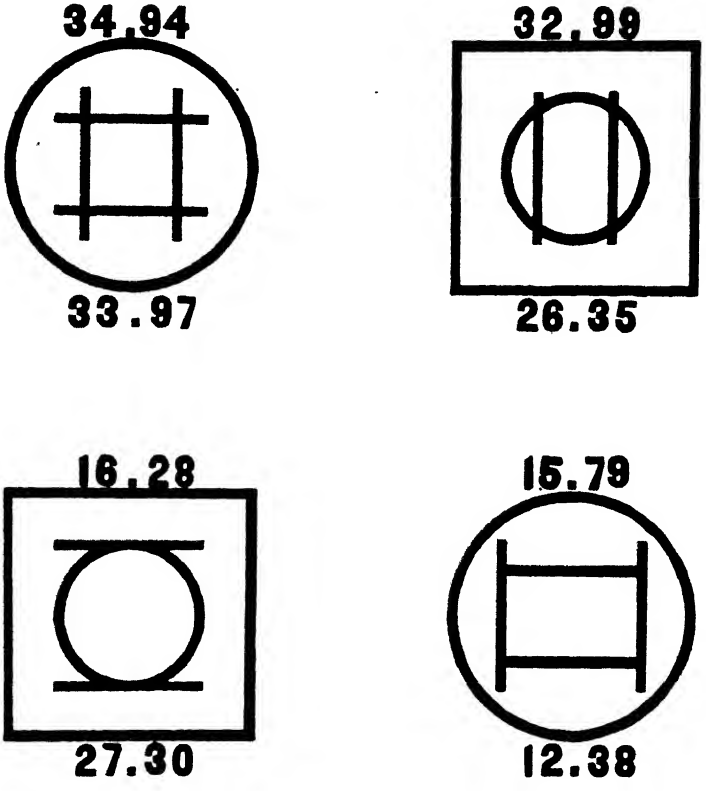


Fig. 49A—Percentage of learning time devoted to each of four designs and the relative achievement. (Numbers above the designs indicate time and numbers below the designs represent achievement.)

The difference in the frequency of the horizontal to vertical movements in observing the symbols is in the ratio of about 2:1, while the vertical to diagonal is in the same ratio. The correlation co-efficients between excursion frequency and excursion distance to fixation time

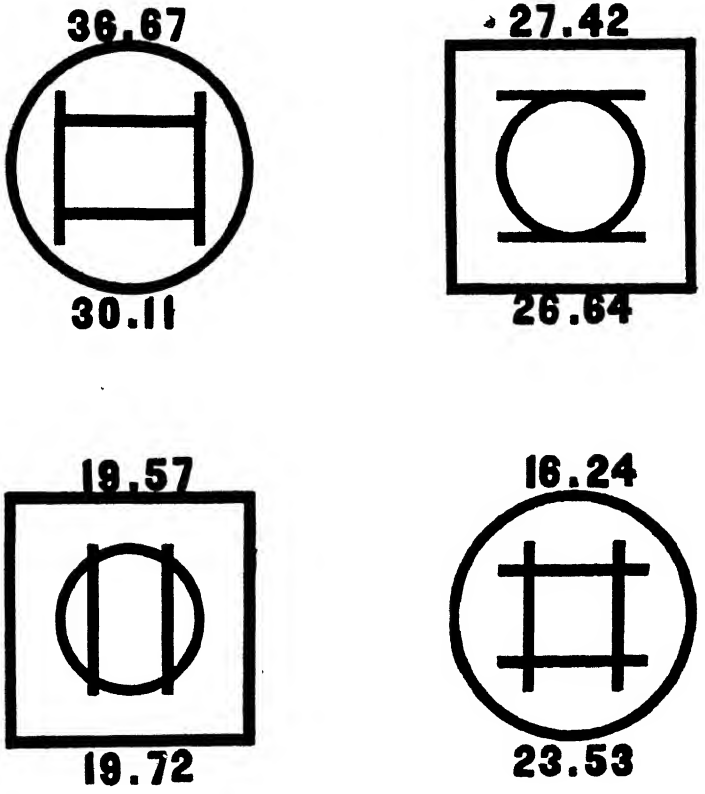


Fig. 49B—Percentage of learning time and achievement when designs of the exposure card were reversed.

Fig. 49A and B—Exposure cards A and B; the symbols on Exposure Card A are identified as (1) upper left (2) lower left (3) upper right (4) lower right. Card B (1) lower right (2) uper right (3) lower left and (4) upper left.

are .95 and .92 respectively. This close relationship between three measures of ocular performance implies that if a specific time is spent in an area the frequency and distance of excursion will vary proportionally.

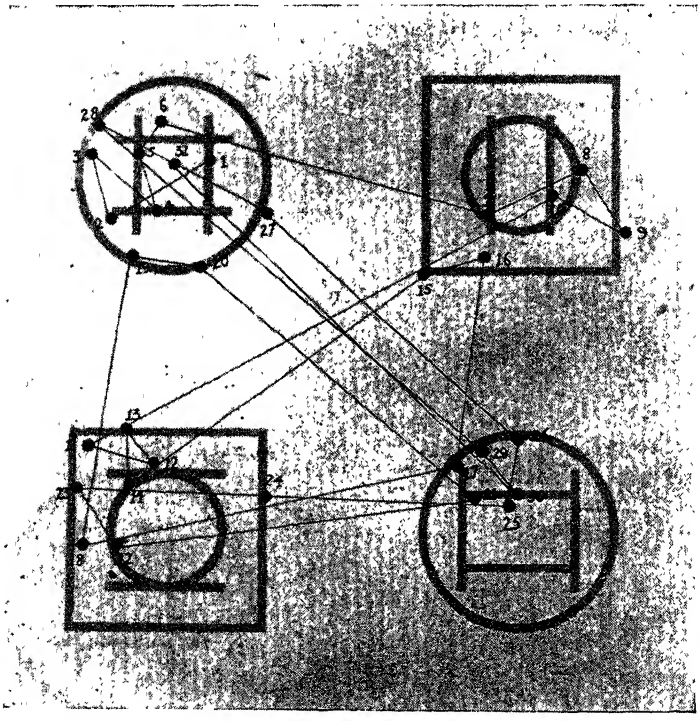


Fig. 50—Ocular Pattern of subject 46, Achievement 7 units.

4. *Low vs. High Achievement*: To conclude whether the ocular patterns of the high achievemnt group are different from those of low

achievement is to analyze the ocular pattern in units of time and achievement.

TABLE XIX

Average Fixation Time Per Unit of Achievement for Subjects of High and Low Achievement.

Card	Symbol	1	2	3	4	Total
A	High Ach.	1.19	.81	1.46	1.19	1.17
	Low Ach.	1.93	.93	2.46	4.06	1.93
B	High Ach.	.80	1.21	.92	1.74	1.17
	Low Ach.	1.64	2.07	3.91	2.08	2.18
A & B	High Ach.	1.02	.98	1.22	1.53	1.17
	Low Ach.	1.82	1.52	2.91	2.44	2.05

The above table shows that subjects of low achievement devote nearly twice as much time (2.05 sec.) to acquire one unit of subject matter as do their superior competitors who devote only (1.17 sec.) to achieve a unit of the same type of subject matter.

The greatest margin of difference between those of high and low achievement is in symbol number (4) when appearing in the lower right hand position. The high achievement group spent an average of 1.19 seconds to acquire one unit of symbol (4) while the low achievement group spent an average of 4.06 seconds for every unit correctly reproduced.

From all indications it would seem that position (for symbols more difficult to reproduce) is a greater determiner of the level of achievement for those of low than for those of high achievement. The low achievement group spent an average of 4.06 seconds when symbol (4) appeared in the lower right hand position and only 2.08 seconds when the same symbol appeared in the upper left hand area, while the high achievement group had a ratio of 1.19:1.74 for

the same symbols. This difference is much smaller (1.93 to 1.82) for symbol (1), a more familiar symbol when appearing in the two positions. The ratios are 1.19:1.93 and 1.93:182 for the high and low achievement groups respectively.

Conclusions

Based upon the results of this study, it is apparent that both time spent and information gained are greater for symbols presented in certain positions. The differences for both time and achievement are significant for the positions analyzed.

Since the frequency and direction of excursions reveals a preference, it follows that the presentation of subject matter is a vital factor in determining learning efficiency.

Consistently more time is spent by subjects of low attainment for each unit of achievement than by their competitors of high accomplishments. Ocular patterns are affected by the position of symbols, and the character of the observed field as well as by the intellectual ability of the observer.

The location and sequence of ocular fixations, the excursion distance and direction imply psychological operations which function in terms of retention and have a future reference. Ocular patterns viewed in the light of learning constitute an expression of the discovery of relations which exist or which according to the learner should exist among the components present. Organization in this sense of the term is no longer an abstract idea, but has meaning in terms of ocular performance implying methods and procedures employed by the learner.

If intelligent guidance of learning presupposes a knowledge of the method employed by the learner, then ocular patterns are likely to provide a valuable criterion for evaluating the learning process and consequently establish a criterion of learning efficiency.

The analysis of ocular performance by means of photography may determine for it the place it shall take among educational methods which have contributed in providing a more adequate procedure in the educative process.

The writer believes that Ocular photography will play an increasingly larger role in evaluating learning procedures in the future than it has in the past for all kinds of materials and individuals. Since the ocular pattern is a record of the ocular preformance in a given task, it provides the teacher with a knowledge of the methods employed by the learner and indicates the level of his efficiency.

Learning as Organization

Organization as expressed in ocular performance is no longer an abstract idea. It has meaning in terms of methods and procedures employed in acquiring a certain type of information. How the child attacks his problem, how he proceeds, and how he distributes his effort are all revealed by this technique.

By means of ocular photography, records of earlier and later performances may be compared as well as performance under different types of conditions or instruction. Remedial procedure may thus be provided in order that the learner may gain with a minimum of effort a maximum of information and satisfaction.

METHODS OF STUDY

To illustrate the difference in methods of learning employed, 50 students were requested to study the symetrical design, with the intention of reproducing the figure later. Each subject was given 20 seconds in which to study the layout.

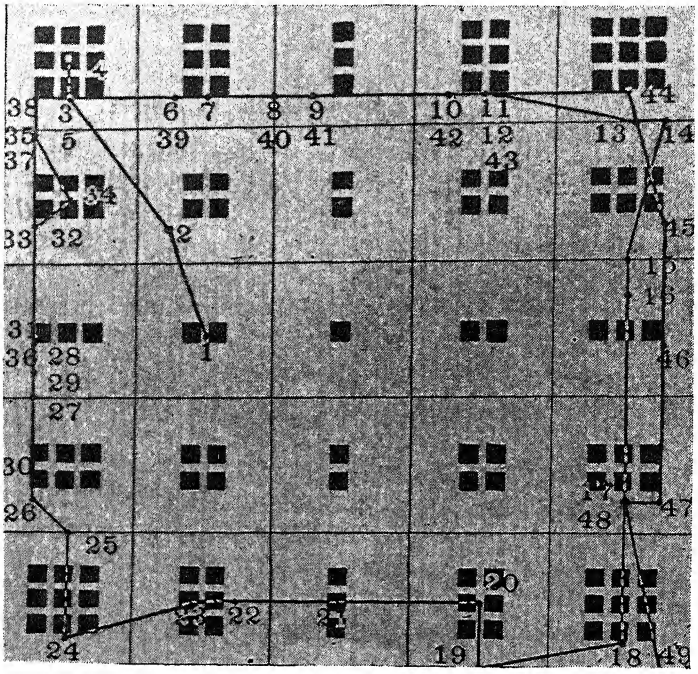


Fig. 51—Ocular pattern of Subject 14. Achievement score, 40 percent of a possible 100.

It is apparent that subject 15, Fig. 52, covered the area much more systematically than did subject 14. The excursion distance for subject 14

is twice as great per unit of achievement as it is for his superior competitor. This no doubt, is due to the intellectual level and previous training of the learner.

Subject 15 employed a surprise attack on the problem as compared to subject 14. However, only a subject of superior intelligence would

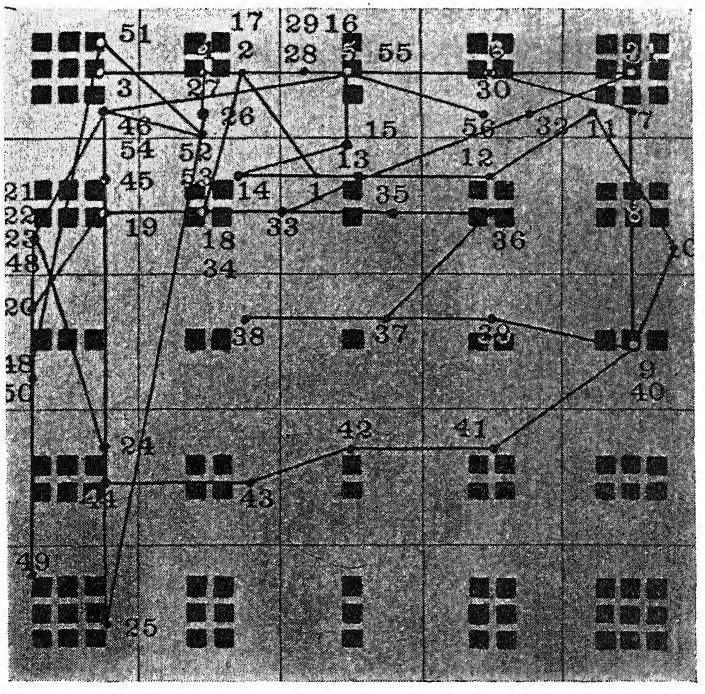


Fig. 52—Ocular pattern for subject 15. Achievement score, 100 percent of a possible 100.

profit by this attack since a high intellectual level and high degree of insight are necessary to gain the desired end. To memorize a few items

and to remember much is the secret of efficient observation. Subject 14 evidently attempted to memorize many details but retained only a few general principles. The subject with low achievement reproduced only a portion of the material where he looked, while he failed to reproduce anything where he had not observed.

Insight plays a very definite role and simplifies an otherwise complicated pattern. Learning in this sense of the term implies that the learner gives it meaning and significance. Subjects who, due to their intellectual ability, had the insight to see the dots arranged in a progressing order from one to three in all four directions had a comparatively simple task as compared to those who failed to see these relationships.

Geometry: It was the purpose of this study to analyze the ocular performance of good and poor geometry students in the study of geometric content. Twelve high school students who had completed two semesters of geometry were selected and the group was equally divided on the basis of grades received in the course preceding this test. These students were instructed to match the figures which to them seemed equal in both form and size.

The results of the two groups are indicated in table xx and reveal (1) the relative number of problems answered correctly, (2) number of fixations, (3) fixation time and excursion distance per unit of achievement (the time limit was 45 seconds).

Based on table xx it is apparent that the poor students make approximately three times as many fixations and travel about three times as

TABLE XX

AVERAGE DIFFERENCE IN OCULAR PERFORMANCE OF POOR AND GOOD GEOMETRY STUDENTS

	Inferior	Superior
Grade point average	1.5	3.0
I.Q. Otis test average	104	118
Correct Answers	13	30
Time in sec. required to complete test	42.90	38.63
Fixations per unit of achievement	11.70	4.30
Excursions in mm. per unit of achievement	463.77	160.26

far for each unit of achievement. (A correct answer is considered a unit of achievement.)

Due to the small number of cases no statistical treatment of the data is made, but the study has revealed certain ocular tendencies character-

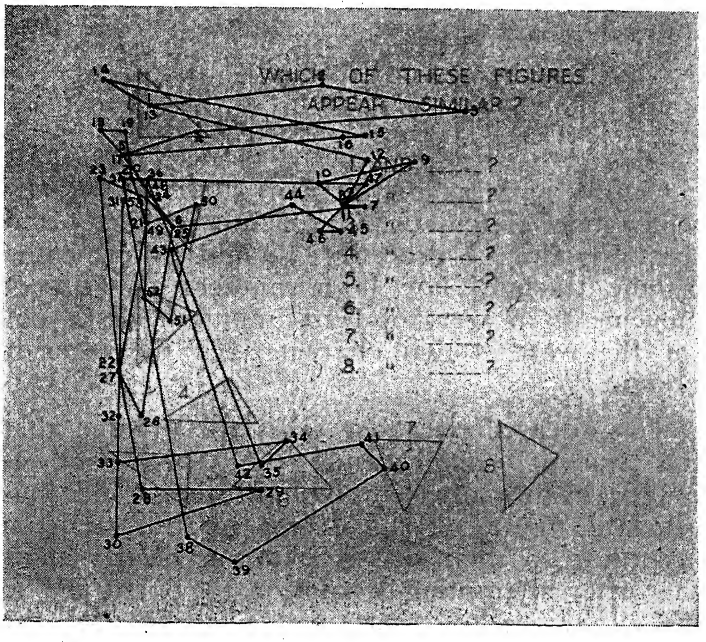


Fig. 53—Ocular pattern of subject observing geometric context.

istic of inferior and superior students in attempting a solution for a geometric problem. One tendency common to the inferior students was the apparent inability to systematically attack the problem. This was revealed by many random movements and hence, accounts for the greater number of fixations and excursion distances.

No doubt, indecisions, confusion, and bewilderment are responsible for some of the erratic patterns obtained. In recording the time preceeding the recording of the first answer, it was found that the superior student made more exploratory movements than did his inferior competitor. The superior students remarked that the answers to problems 5, 6, 7, and 9 were the reverse of the first four. None o the inferior students made this statement.

TEACHING SUGGESTIONS

Ocular patterns of inferior students indicate that a more systematic approach is necessary and that a systematic procedure should be presented by the teacher. The large number of random movements in areas of least importance is proof for the waste which characterized the inferior group.

Too often, the teacher takes for granted that the student comprehends the assignment as judged by his apparent thoughtfulness and juggling of figures. Many of the inferior subjects, according to their ocular patterns, clearly show that after attempting a solution they returned to the directions to ascertain the purpose of the exercises. To teach a student how to study is probably as important as what to study. Exercises

which tend to develop students' ability to observe clearly and rapidly should become an important part of every class room procedure.

It seems clear from the evaluation of ocular patterns that there is a tendency to break down rhythmic habits especially when difficulties are encountered. The subject, as illustrated in Fig. 53 evidences a superior attack on the problem as compared to those of lower achievement. The ocular pattern of this subject reveals clearly a systematic procedure. However, only a subject of superior ability would profit by this attack since a high degree of retentiveness is necessary in order to profit from the course here illustrated. This subject answered all questions correctly in a period of forty-five seconds.

Algebra: This study was an attempt similar to the study of geometry reported above in that the ocular patterns of inferior and superior subjects as based on achievement in algebra were compared.

Subjects selected for this study were high school students who had completed the second semester of elementary algebra. Ten subjects, five inferior and five superior as based on their scholastic records, were instructed to match the statement on the left with the formula on the right.

TABLE XXI

DIFFERENCE OF OCULAR PERFORMANCE OF SUPERIOR AND INFERIOR STUDENTS IN ALGEBRA

	Inferior	Superior
Grade points	1.20	3.90
Otis I.Q. test average	102	115
Fixation frequency per unit of achievement	47.10	33.60
Excursion distance per unit achievement	1299.10	929.50
Number ef excursion made between two columns por unit of achievement	4.74	2.89

The finding of this study were similar to those obtained in the study of geometry in that subjects revealed ocular patterns inadequate for their purpose.

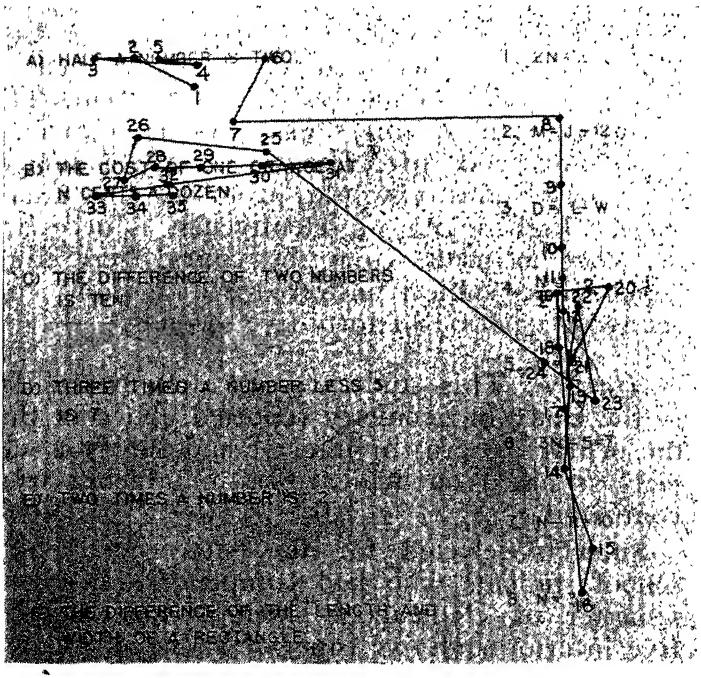


Fig. 54—Ocular patterns of subject—1st 15 seconds superior student.

The inferior subjects made nearly twice as many excursions between columns as their superior competitors. This large number of excursions for the inferior subjects indicates that many returns were made to the work statement for purposes of rereading and reinterpretation.

This resulted in wasted energy and lost time. The number of subjects used for this study will not permit statistical treatment for purposes of generalization and application of findings to larger populations.

Arithmetic: Subjects were requested to observe

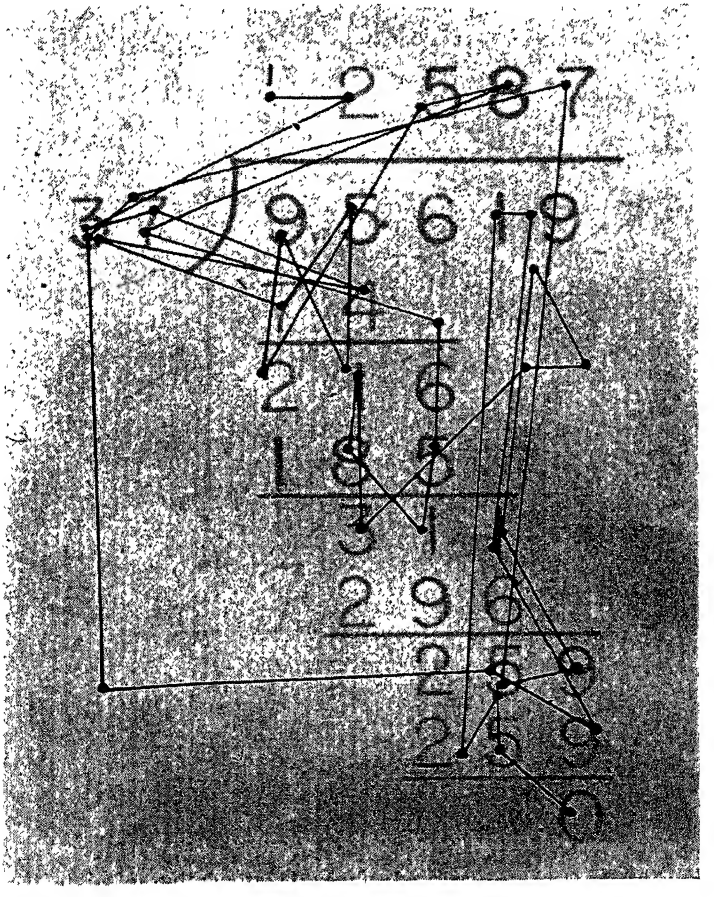


Fig. 55A—Ocular pattern of subject 12.

a non-apparent quotient problem in long division with the intention of finding the error if there was one. Subject 12 very carefully checked each diget relation and concluded that the problem was correct and, therefore, no error could be found.

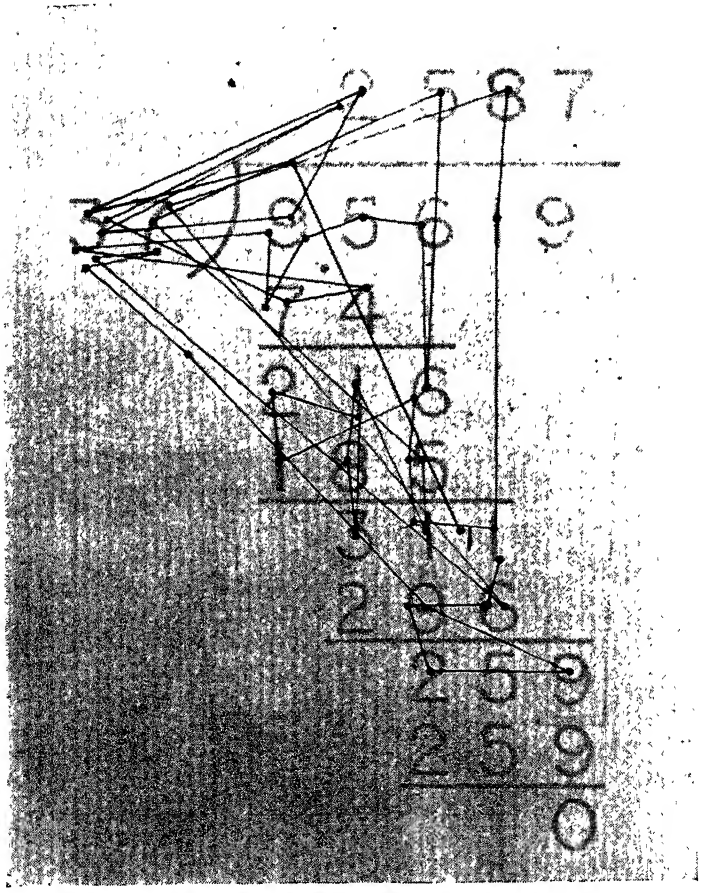


Fig. 55B—Ocular pattern of subject 18 attempting to locate the error in the problem.

Following the sequence of the pattern, it is evident that he did not fixate on digits nine and one to note their relationship and, as a result, failed to find the error.

Subject 18, as illustrated in Fig. 55B, observed the same problem with the same intents as subject 12 but discovered the error. Both subjects were seniors in college with a 3.5 grade point average. In both patterns the excursion frequency distance contrary to eye movement tendencies is greater in the vertical than in the horizontal direction. This was necessitated by nature of the content observed.

Problem solving: As in learning problem solving involves mental processes of seeing relations and making proper deductions. To illustrate this principle Fig. 56 was selected. Twenty-five subjects were requested to observe the designs and to press the signal key as soon as they had obtained the answer to the question "What is a DAX?" The time was limited to 40 sec. but no subject knew of the time limit.

TABLE XXII
RELATIVE TIME DEVOTED TO DAX AND NON-DAX IN PROBLEM SOLVING

	Correct answers-9 subjects			Incorrect answers—16 subjects		
	Total Time	Av. Total time	Percent of Total time	Total time	Av. Time	Percent of Total time
Dax	156.00	17.73	70.59	349.66	21.85	66.10
Non-Dax	65.00	7.22	29.41	179.34	11.21	33.90
Total	221.00	24.55		529.00	34.06	
Excurs.	80.00	8.89		193.00	12.06	

The purpose of the test was to discover the relative time (those who solved the problem correctly and those who failed in their attempt) spent on the designs designated as Dax and Non-Dax of the problem. Table 22 is self-explanatory

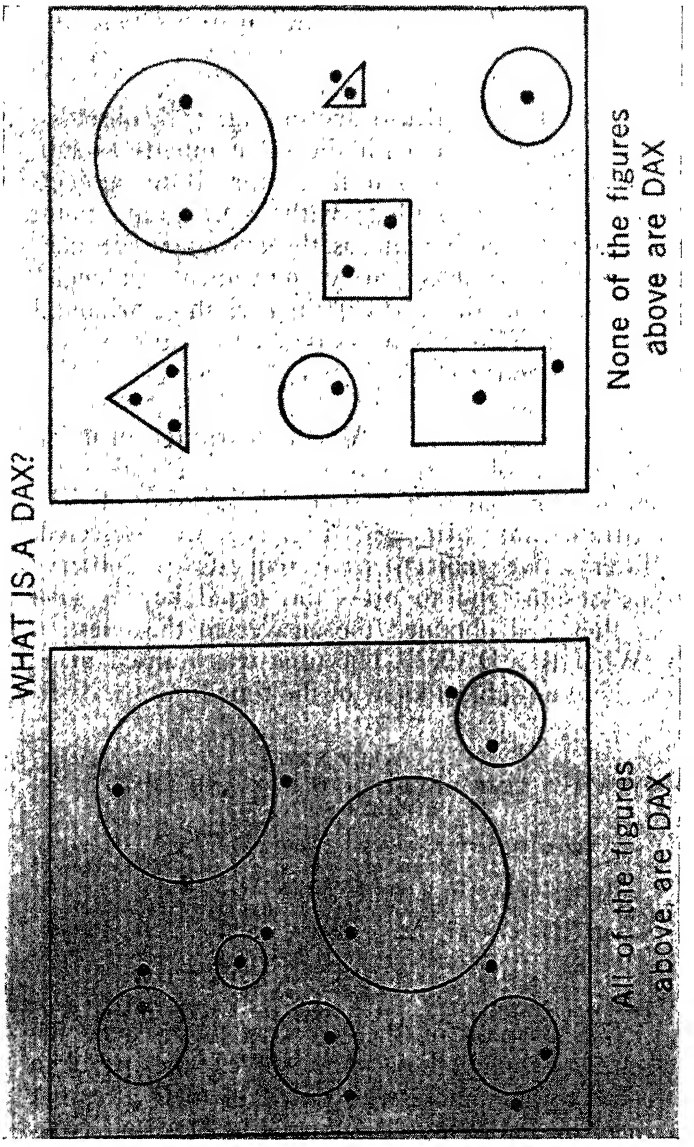


Fig. 56—Subjects studied this card for 40 sec.

and shows the difference between those obtaining the solution and those failing to do so in the allotted time.

It is evident that the subjects who obtained the correct answer in the allotted time devoted less time on the Non-Dax than did their inferior competitors.

The nine subjects who obtained the answers in the 40 seconds devoted less time to the problem, spent less time on the Non-Dax designs and made fewer excursions. This is as it should be. However, since answer can be obtained without observing the Non-Dax the superior subjects should have devoted even less time on the Non-Dax than they did.

Based upon this study we might assume that the method employed by subjects with superior ability may still be inadequate. Even if they solve the problem correctly their procedure could be materially improved. This same principle would apply to the inferior learner, naturally.

Spelling: Two ocular patterns illustrated in Fig. 58A and 58B are the results of two boys attempting to locate the word spelled correctly for each of the twelve lines. The answer to each of the four words of each line was recorded by means of a contact key on the camera. Subject 11 was a boy of twelve years of age in the seventh grade and subject 12 was a boy of fifteen and in the same grade.

From the ocular patterns of these two subjects it is evident that the superior pupil carefully selected the words spelled correctly, while the subject with the inferior intelligence moved over the page haphazardly without much discrimi-

nation or differentiation between words spelled correctly or incorrectly.

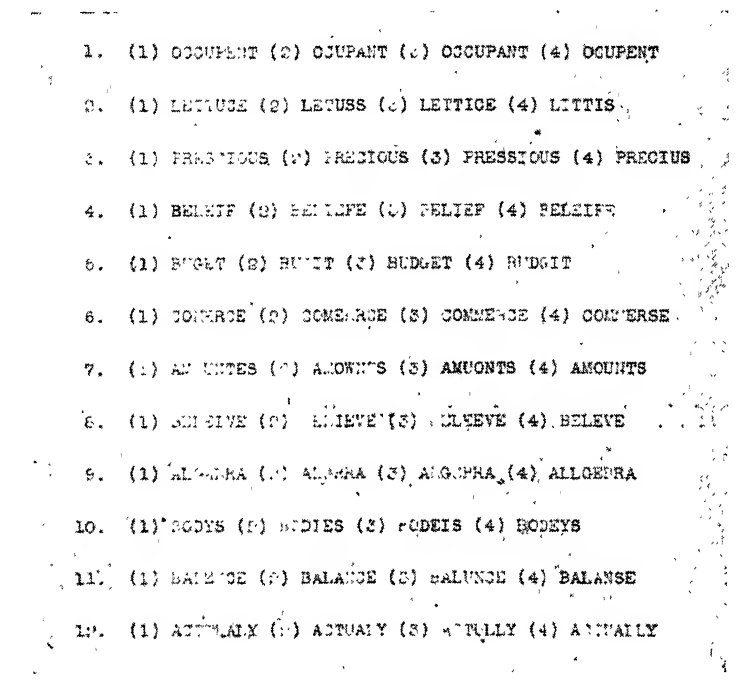


Fig. 57—Spelling words used for the correct word identification.

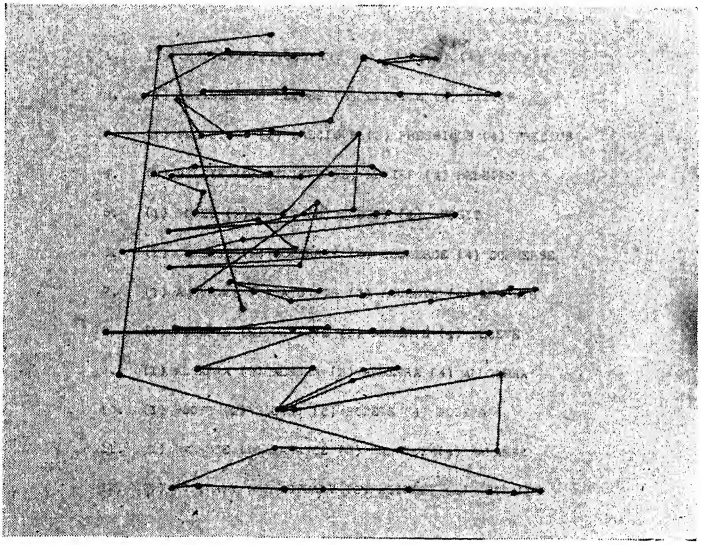
From data in table 23 it is apparent that the difference in ability and achievement of the two subjects is pronounced. The fixations of subjects 11 are haphazard and random while those of 12 are systematic and orderly. The writer asked sub-

TABLE XXIII

BREAK DOWN OF THE OCULAR PERFORMANCE OF SUBJECT 11 AND SUBJECT 12

	Subject 11	Subject 12
Intelligence Quotient- Otis	128	70
Percentile on Iowa silent reading test	98	5
No. words correctly identified	12	2
Total no. of fixations	104	70

ject 12, who identified correctly only two words, why he proceeded to look at the last lines of the word list when he was reading line three. He said, "Professor, I'm sorry but I didn't like the stuff and so I looked at the last line to see how soon I would be finished."



Fif. 58A—Ocular patterns of subject 11—eleven words correctly identified.

The ocular pattern of subject 12 clearly indicates that his method of observation was distinctly inadequate. This subject attempted only the first seven questions in the time allotted with answers as follows: 1-4, 2 -2, 3-2, 4-3, 5-2, 6-2, and 7-3.

It is obvious that the main purpose of subject 12 was simply to finish the task. This is a typical example of the reaction of many students when a premium is placed on speed.

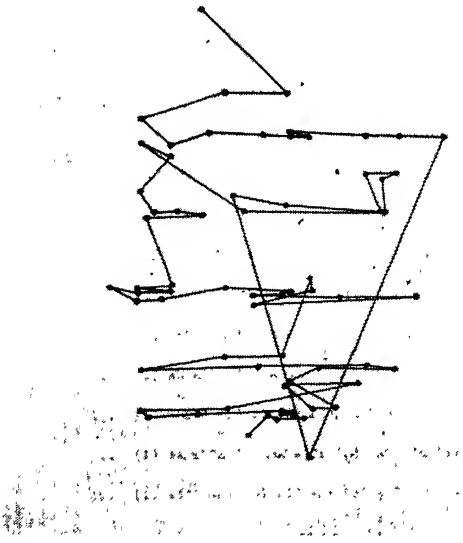


Fig. 58B—Ocular patterns of subject 12—two words correctly indentified.

Geography. Ocular patterns, as such, are indicative of the level of intellectual achievement and acquired modes of behavior. Fig. 59 and 60 illustrate the ocular patterns of two subjects attempting to locate the capitol of Georgia.

Subject 22 located the capitol in less than two seconds and did not waste her time in states west of the Mississippi River. Additional fixations were made because of curiosity according to the subject's report later.

Since the eye movement technique analyzes more directly the process accompanying mental process (rather than the final achievement score, as is the common practice), it may gain for the teachers and supervisors a clearer un-

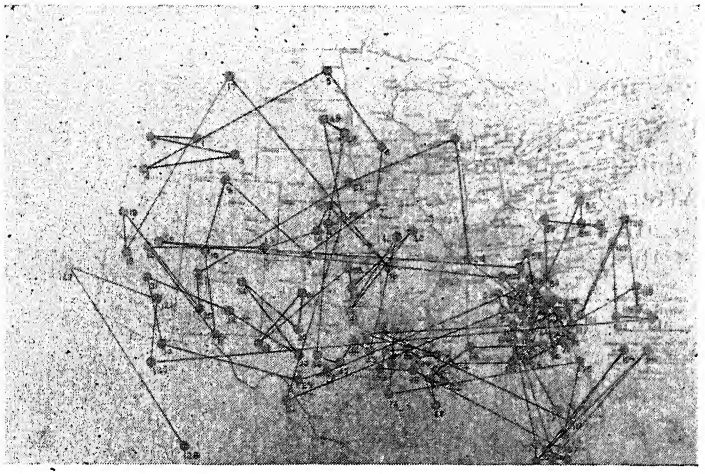


Fig. 59—Subject 15 attempts to locate capital of Georgia.

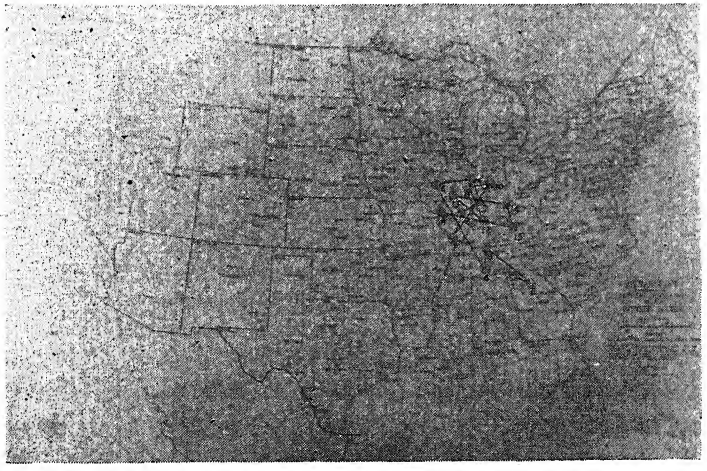


Fig. 60—Ocular pattern of subject 22.

derstanding of the learning process and may furnish a basis for diagnostic and remedial procedures. Proper direction and instruction can only

follow when the process itself is known. By means of Ocular Photography it should be possible to verify the assumption that achievement presupposes an efficient process.

Notice the excess number of fixations made by subject 15 before the state of Georgia is located. After the state was located, the subject failed to locate the capitol since she did not know which of the names in the state represented the capitol.

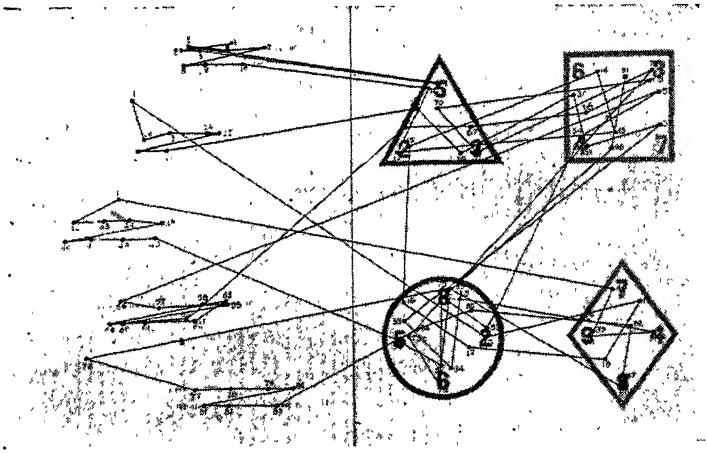


Fig. 61—Subject (10) attempts a solution to the questionare. Answers the five questions correctly in 39.5 seconds.

Intelligence testing: Innumerable tests have been developed to ascertain the intellectual level of individuals. Based on such tests, numerous theories of the nature of intelligence have been advanced until today it is quite clear that intelligence is a native trait similar to other anatomical characteristics of an individual. However, recent studies have shown quite convincing-

ly that early and subsequent training have a definite effect on the level of ability finally attained. At any rate, the performance in a situation is the final criterion to judge the ability which lies back of it.

Without entering into the controversy and misunderstanding about the relative influence of nature and nurture on our intelligence, the writer contends that much about the intelligence of an individual may be discovered by studying his ocular performance.

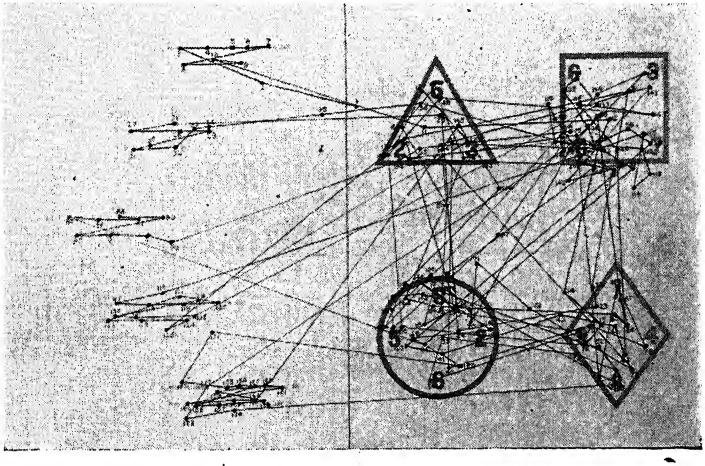


Fig. 62—Subject (15) answers only 2 questions correctly in 101.5 seconds.

Figures 61 and 62 illustrate the ocular pattern of two subjects attempting an answer to the same problem. Subject (15) made twice as many fixations, significantly more movements, and traveled almost twice as far as unit of achievements as did subject (10) his superior competitor. This may signify lack of comprehension, retention power, or both.

The superior subject evidences a systematic and intelligent method of procedure and naturally travels a much shorter distance per unit of achievement with significantly fewer fixations. Efficiency gauged by this technique is not measured by the product alone but by the method employed by the learner in obtaining it.

Ocular performance may in the future play a definite role in the evaluation of the intellectual ability or abilities of individuals and supplement our present method of evaluation.

FOVEAL VERSUS PERIPHERAL VISION

Throughout all the possible psychological implications of ocular performance when related to learning is found that of the relative function of foveal and peripheral vision. Man was originally an animal employing largely peripheral vision, but the progress of civilization has resulted in more and greater demand for refined discrimination so that, today, science, education, and industry demand an increasingly larger use of foveal macular vision.

Experimental psychology has demonstrated beyond a doubt that the fovea is the area of clearest and most distinct vision of the retina. Although this area is only about a millimeter in diameter, it serves a very necessary function in gaining accurate information for the individual from his environment.

If both foveal and peripheral vision have a place in the acquisition of information, commonly called "learning" then it becomes our duty to investigate the relative function of each in or-

der that we may determine when and to what degree each should be employed in the learning process. The major function of the periphery is that of orientation, or recognizing form, movement, and intensity. It serves as a mechanism for protection and is indispensable where gross adaptations are expedient. Foveal or macular vision serves as a mechanism for accurate differentiation and discrimination. The above-named division of labor does not include all the duties of the two areas designated, nor does it imply that the distinction is absolute. It only implies that each has a function typically its own because of its anatomy.

As a result of this investigation, the writer has come to the conclusion that we have gone "peripheral" in our educational procedures. Mills believes that "because of the emphasis on speed, the visual mental adjustment employs peripheral vision and, therefore, tends to replace accuracy by impression and in turn generates inadequate perception, poor memory, inaccurate reasoning, and bad mental habits. It may even lead to disordered conduct and a warped personality." This seems especially true for those who with only limited intellectual and physical capacities, are compelled to compete with their superiors in the marathon of educational demands.

The school of speed to which a large percent of our modern educators belong believes that since the periphery is a much larger area than the foveal area, it should find a much greater place in training the child than is the case in present practice.

If accuracy is a major quality of perception,

and if the adequacy of mental processes depends on the character of this mental content, then we need to inquire, from data obtained under scientifically controlled conditions, what form of ocular performance we desire in order that the learned may gain the maximum information with a minimum of action.

It is the belief of the writer that accuracy generates speed, but the postulate that speed will generate accuracy does not seem feasible. This he holds to be the order in motor as well as in abstract learning. Regardless of the point of view, no method of acquisition is to be recommended or accepted which destroys accuracy.

Based upon the native capacity of an individual, there is a very definite rate and limit of speed of perception and cognition. Dodge points out that each new stimulation has a latent period of incubation and a period of more or less incompletely inhibited development before it reaches full maturity. The clearing-up process varies with different individuals and may be said to begin with the new stimulus and terminate whenever it is differentiated from its predecessor. Whenever the normal speed of the subject is exceeded, he is penalized in terms of inaccuracy of recall and is robbed of the self-confidence which follows when one is correct in the solution of a problem.

The psychological implications of ocular patterns, as applied to the relative emphasis of foveal and peripheral vision, constitute probably one of the major unknown factors in the intelligent interpretation and direction of the learning process.

Even if this difference is only a matter of

emphasis, it, no doubt, determines to a large degree the selection of subject matter and methods of presentation. It may even determine the philosophy underlying the purpose and alleged function of educational procedures. In fact, such a concept might be responsible for the birth and perpetuation of an entire system of education.

The manner in which we see has, we believe, an important bearing on our abilities in different vocations. If an individual employs peripheral vision, the type which attempts to see the whole situation at a glance, the chances are that such an individual would make a good basketball or football player because in those sports a more comprehensive view is essential.

Persons with this kind of vision are likely to make good automobile drivers and to have fewer accidents. It is the man who can see behind, in front, and at the side as well, who rides most safely. This type of vision is especially useful in situations which demand a quick orientaton. It is a mechanism for protection where instantaneous changes and adaptation are necessary. It is indispensable in many vocations.

People who use foveal vision, in the main, use their eyes for accurate discrimination. Individuals of this type make poor athletes. They are at a loss in situations which demand quick adjustments and adaptations. Lawyers, teachers, mechanics, dentists and optometrists need vision of this type.

The psychological implication of ocular patterns resulting from observation of different individuals in various situations leads us to postulate that the ocular performance will, if properly

evaluated, reveal the character of the individual as well as the task he is required to perform. It may lead to an evaluation of aptitudes and abilities not readily discovered by other methods of investigation.

LEARNING TO READ

With the ever increasing complexity of the demands of the social order, manifested by the multiplication of books and periodicals, the profusion of advertisements in local and national publications, and the increasing number of fast moving vehicles and machines, visual efficiency is becoming more and more essential. It is for such reasons that the problems of reading and reading efficiency should be a matter of chief concern to every one.

We can hardly expect to place our hand or focus our eye on any phase of modern life without recognizing an invention to facilitate human adjustments. Telephones, typewriters, fountain pens, radios, refrigerators, and comptometers, all in one way or another have increased the efficiency of the human organism manyfold and have provided for expressions unknown to our predecessors.

Whatever the human mind learns for the purpose of adjustment is a rule inadequate, inaccurate, and inefficient unless properly directed in the initial and subsequent stages of acquisition. Whether an individual is playing a piano, operating a press drill, running a typewriter, or playing golf makes little difference. Industry has demonstrated that movements properly directed and trained increase the quantity and quality of

output from 50 to 400 percent. Efficiency has become the keynote of modern industry.

What have we done to improve our reading efficiency? Are we better readers today than we were 100 years ago? Is it possible to improve our reading speed and comprehension?

If directed training has proved practical and profitable in industry, does it seem feasable that ocular efficiency could be increased if the motor processes were known? Despite our low degree of illiteracy only 16 2/3 percent of the adults read as well as the average high school student; and only 40 percent have a reading ability of the sixth grade.

It is estimated that the reading demands have increased more than 200 percent since 1900. This applies in varying degrees to grade, high school, and college education as well as to business and the professions. Pupils in schools fail more frequently in reading than in any other school subject and 15 percent of the failures in other subjects are directly or indirectly due to reading habits.

Reading diagnosis: Progressive educators are attempting to improve the reading habits of those now in our public schools in order to prevent another crop of poor readers such as we of the present generation have turned out to be. Until recently, reading habits could not be tested objectively; and, consequently, even the educators were not aware of the tremendous individual differences of good and poor readers.

One of the most scientific methods of accomplishing this task is the employment of an eye camera which provides a record of the eye movements of the child or adult as he reads.

By means of this instrument the fixation frequency and duration, as well as regression frequencies, can be measured.

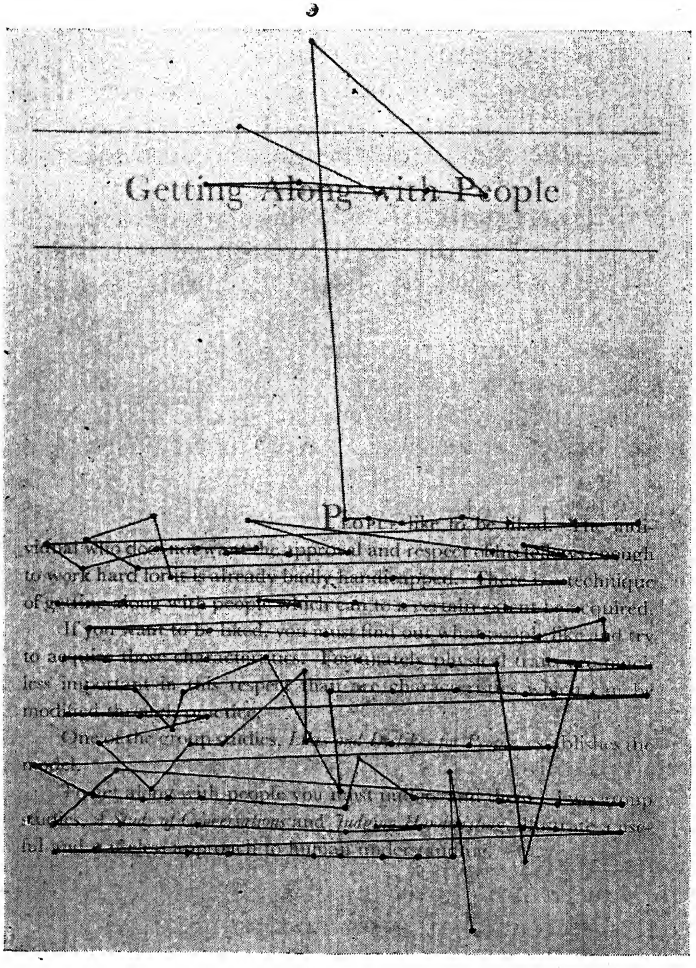


Fig. 63—An ocular pattern of a male college student reading a standard page of print. (Subject reads 270 words a minute. This is below average for his classification.)

To demonstrate just how this is accomplished let us take a subject into the laboratories to see how well he reads. The camera operator requests

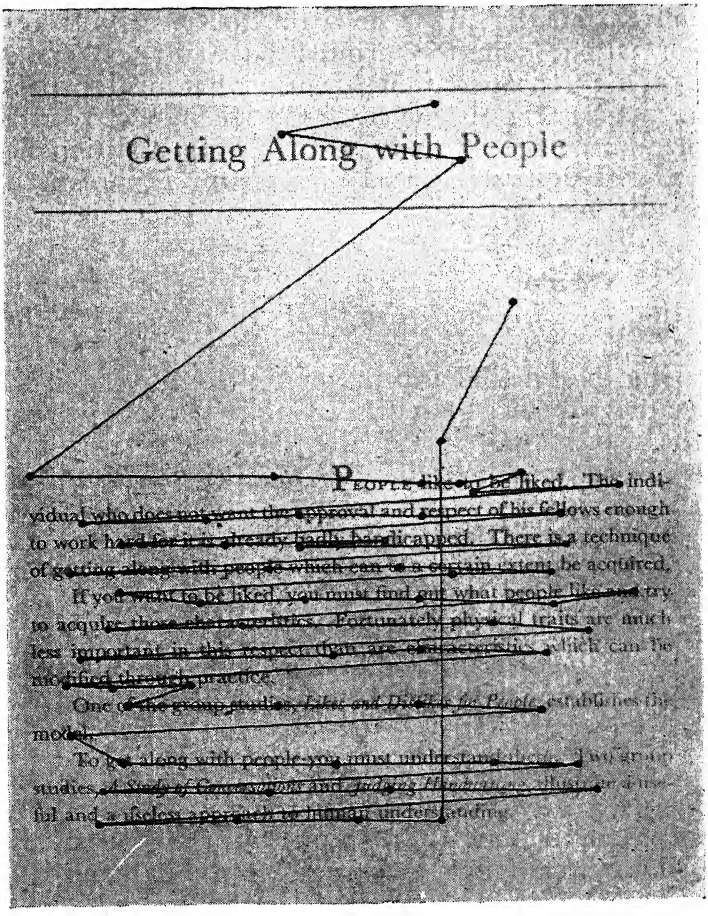


Fig. 64.—College student reads 480 words per minute. This is above average for his classification.

that the subject sit down in front of a machine called an Eye Camera. He is requested to read a standard page of copy during which time the camera photographs every movement of his eyes. After the reading he can observe just what eye movements he made to gain the necessary information from the printed page. Fig. 63 is a graphic representation of just what ocular performance was employed while the subject read a standard page of printed matter. In addition he answers uestions related to the copy he just read to discover his capacity for comprehension.

This record indicates that the eyes do not glide smoothly across the lines of print but rather in a series of jumps; fixating successive points along the line. The duration and location as well as the sequence of each fixation is recorded by the camera and serves as a valuable record and criterion to determine the reading efficiency of an individual. As stated earlier, about 90 percent of the time is devoted to fixation time, while 10 percent is devoted to movements. Following this camera test the subject will be requested to answer questions dealing with the material observed to determine how well he understands what he has just read.

Objective measures: How well we read is no longer a matter of guessing but is a science. By means of ocular photography every fixation, as well as every eye movement, can be identified and analyzed. The number, duration, and location of every fixation, together with the direction and distance of every excursion or eye movement is recorded on a sensitized film and thus provides a comprehensive picture of the reading

habits of individuals. The photographs are highly significant and valuable in diagnosing the reading ability or disability of individuals.

These records become accurate and valuable reproductions of the patients' eyes under normal reading situations. Photographic records of the ocular performance during the reading not only aid the diagnosis of reading habits but provide a special technique to evaluate the improvement or increase in reading speed resulting from remedial procedure.

Poor readers, as would be expected, make many unnecessary eye movements. Besides requiring many more fixations per line they develop a habit of returning to materials previously read for purposes of reinterpretation on the basis of words read later. Such movements are called regressions and are often due to the limited vocabulary of the reader, low intelligence, or inadequate training.

TRAINING OF EYE MOVEMENTS

Just what relative part nature and nurture play in determining for the individual a certain ocular pattern when reading is not clear at this time, but it is evident that their character can be changed by merely altering certain methods of presenting subject matter or giving specified directions prior to learning.

In a study of educability of ocular motor patterns Bott, Brown and Cohen report an experiment designed to ascertain whether the eyes will learn a different set of motor patterns. Although their results are too meager to warrant general conclusions, they suggest,

> That radical modifications in oculo-motor patterns can be learned, or to be more specific, they say,
>
> We feel the results are sufficiently positive to show that an ocular motor pattern such as that of vertical coordination which is fairly consistently inhibited in normal visioin may to some degree, at least, be quickly facilitated when circumstances demand such adjustment to meet the needs of visual perception.

Whether the primitive pull or acquired disposition are the major determiners for certain ocular patterns is still a psychological problem. Regardless of the relative influence, the writer is of the opinion that if a subject will employ a certain method in reading, he will, over a period of time, develop an ocular pattern characteristically his own. It is only reasonable to believe that this pattern will carry over into fields other than the ones he has been observing.

Does it seem reasonable to believe that an individual with a relatively low intellectual level continuously submerged in a mass of subject matter which he cannot, by any means, comprehend could develop an ocular pattern habit quite different from one whose requirements are geared to his capacities?

Diagnosis: To discover the reading level by means of modern instrumentation is a very important step although only a part of the entire procedure. If we go no further than to give an intelligence test to a child or make a medical examination of a patient, we might as well have saved the expense of the diagnosis.

To evaluate the reading deficiency of an individual implies at least three fundamental conditions and procedures:

To know that a disability exists and to what extent. (Standards).

To be able to diagnose the case and know which of many possible causes are responsible for his condition.

To know (in the face of his deficiencies and in the light of approved techniques) how to assist him to read more efficiently.

HOW DO CHILDREN READ PICTURES AND COPY

To learn by the analysis of ocular patterns how adults look at printed and pictorial copy provides a picture of what nature and nurture have accomplished over a period of years. But to see the eyes of children at work is to get closer to native and unlearned ways of human behavior.

In order to discover how children look at and read pictures, children in the primary grade, seven years of age, were selected for an experiment. Pictures were mounted on a large card as shown in Fig. 65. Preceding the test the teacher asked certain questions and gave the following instructions:

Do you like to look at pictures? Soon we will have you look at some pictures. Among the pictures you will see Bob, Nancy and Mac. Bob is a boy, Nancy is a little girl and Mac is a dog. Bob and Nancy and Mac like to play together. One day Nancy wanted to hide. (Who is Nancy?) She wanted Bob and Mac to look for her. (Who are Bob and Mac?) I will show you some pictures and sentences that tell you how they played. I want you to look at the pictures and sentences. Then find a sentence that tells about each picture. When you find one sentence that tells about

one picture press this button. (Camera is equipped with recording apparatus so that the exact location is identified when an answer is obtained.) When you find another answer press it again until you have found all the sentences that tell about the pictures.

The purpose of the test was to discover the general eye pattern of children who had very little training in reading, and to learn from their ocular performance:

Where the initial fixations were made.
How many times each area was entered.
How much time was devoted to each of the twelve areas.

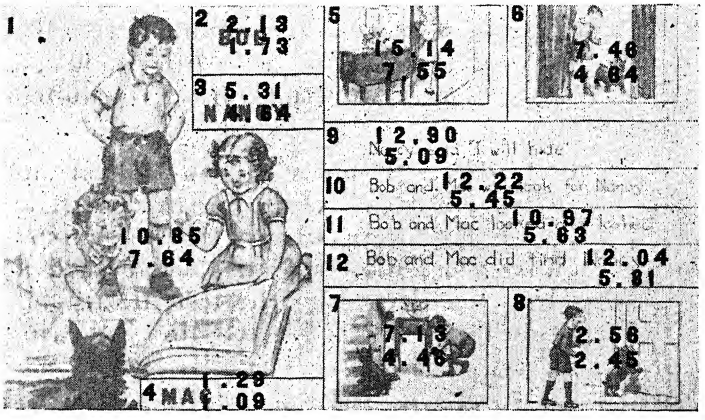


Fig. 65—The percentage of time devoted to respective areas (example 2.13 in area 2) and average number of times each area was entered. (Example 1.73 times in area 2).

Based upon the findings of this study, all but one child made their first and second fixations on the left hand page. The average number of times each area was entered and the relative time devoted to these areas is indicated in Fig 65. The top number, 19.58 percent of the total

time is devoted to the left page with an average of 15.10 entries into different areas, while 80.42 percent of the total time is devoted to the right page with 41.08 entries into different areas.

Children made an average of 6.5 fixation per word.

As might be expected the largest number of entries were made and the longest time was devoted to area 5, the picture explained by the first sentence. Following in order of time and entries were pictures 6, 7, and 8. This corresponds to the ocular performance of adults. If picture 5 had been placed where 8 now is, it is likely that many excursions would have been made to an area which did not yield the answer to the first question.

Although the number of subjects employed in this test is small, the children reveal by their ocular performance that they have a strong tendency to move first to the left then proceed to the right and if a composite line were drawn for the excursions of all these children, the eye would be shown to make its initial fixation of the left page and move to area 5, 6, 7, and 8 respectively.

To construct a layout which follows the natural tendency of eye movements is to enhance learning and increase the efficiency and satisfaction of the learner.

Narrow eye span: Many readers have an eye span which covers only one word or less at a glance. This naturally means more fixations and a longer reading time. A child in the grades makes from six to fourteen pauses per line, while a student in high school makes only about three

to eight. If you are interested in observing the number of pauses a person makes when he reads, take a typewritten sheet of paper, punch a hole the size of a pencil through the center of the sheet, then ask someone to read the printed copy while you watch him through the small aperture. You can also observe him by placing a mirror in front of him and observing his eyes in the mirror while he reads.

Irregular progressions: Poor readers make very irregular progressions along the line of print and an inaccurate return sweep. It is discovered when individuals read under the scrutinizing eye of a camera that they make many regressions, such as returning to certain words or to the beginning of a sentence which they just read. Poor readers as a rule make far more regressions than do those competent in the art.

Are you a good reader? Reading speed is one criterion for judging reading efficiency and based upon measurements of good and poor readers we conclude that one reading less than 200 words per minute is a poor reader; 250 to 350, average; and 500 to 600, superior.

Although reading speed is essential, it is not the only standard of a good reader. A person with a comparatively good reading speed may be an excellent reader because he observes the above rules, has a feeling of confidence, can report in his own words what he has read, and can use the information in conversation and in his life.

Only by reading skillfully and rapidly will we, as an adult population be able to carry on independent thought and reflective thinking. The printed word, althought supplemented by

pictures and radio, still provides wide and intimate knowledge of our past and present existence.

Reading is largely psychological in nature, and eye movement habits may be defined as psychological dispositions to move the eye in reading according to certain cues. Once these patterns are established, as with other habits, they resist change but can be improved by proper reeducation. The fixation span, the accuracy of the retina sweep, and the number of regressions, as well as the fixation frequency are habits of reading and can be objectively measured by eye movement photography.

Faulty eye movements are symptoms of reading difficulty, and rhythmical or consistent eye movements are characteristic of good readers. Reading is the propeller of a mental motion picture machine and if symbols are presented to the eye in irregular non-rhythmical fashion, the mental picture is blurred and lacks continuity and meaning.

Nature has provided us with eyes, light and intelligence, and it is for us to learn how to make the most of all three. The teacher, the parent, the oculist as well as the physician, all in one way or another are responsible for the development of correct reading habits of the present generation of readers.

Increased reading speed is significant, not only as indicies of reading efficiency, but represent ocular habit patterns essential in industry and professional activities alike. This together with greater pleasure, increased comfort, and added comprehension of information, both new and old, are adequate rewards for such improvements.

PART VI

ART—JUDGED BY THE OCULAR PERFORMANCE OF THE OBSERVER

Ocular Photography seeks to interpret painting and sculpture by analyzing the response of the eyes to the stimulus and, secondly, by applying such interpretation to the art object as may be implied in the behavior of the individual. Whether aesthetic appreciation in art is stimulated by large spaces, straight or curved lines, balance and symmetry, proportion, or a combination of two or more of the above, will, in many cases, need to be told by the eyes themselves. Their story naturally speaks in terms of duration, locations and sequence of fixations as well as directions and distance of excursions. As stated earlier, two general patterns of ocular performance are apparent. One of these consists of a general survey in which the eye moves with a series of relatively short pauses over the main portions of a picture. A second is one in which a series of fixations, usually longer in durations, are concentrated over small areas of a given field, evidencing detailed examinations of those sections.

It is maintained that the survey type of perception generally characterizes the early part of an examination of a picture and that subjects looking at a picture for only a short time reveal only the survey type of eye movement.

Just as in learning, one of the major essentials of art appreciation is that of seeing rela-

tionships of color, lines, curves, shades or proportions. The lines may be delicate, firm, vertical, horizontal, or diagonal. Whether these lines express grace, dynamic force, or sheer buoyancy is not our problem here.

We are concerned with what these lines cause the observer to do. Has the subject a tendency to follow certain lines more readily than others? Are the lines so organized as to determine the position of a figure? Are they so placed that they secure a rhythmic movement about the center of interest? Is the subject directed to the major points of interest, and if so, what laws of perception underlie this fact? To study art from the standpoint of interpreting the aesthetic side is only one phase in the study of art itself. Underlying it all is a structure made up of components which, by their very combinations, have a definite effect upon the observer.

It is quite evident that the eye and the mind do not enjoy a haphazard collection of colors, lines and proportions. Therefore, the principle of grouping as in learning is again employed. Groupings are a mental process which itself takes place because of proximity, similarity, contrast, or meaningful relationships in the constellations. Certain parts become unified while others differentiate themselves more completely.

If the success of the design depends upon a degree of correct balance, we may, by this technique, discover what the eye desires under balanced or unbalanced conditions. Since we react to the structural elements of lines, shades and color, it seems plausible that the eye should seek and distinguish those relationships, for, after

all, the adequacy of a design depends to a large degree on the plasticity of these structural elements.

In order to be effective most pictures have one chief center. The mind and eye can grasp only a certain amount of emphasis at one time without resulting in confusion. In a visual experience the eyes may follow certain lines, experiencing, as it were, an ease of movement; or they may be suddenly halted, breaking the rhythmical pattern.

"Lines", says Chandler, "owe their expressiveness to a type of process called empathy". As the mountain rises, our eyes perhaps trace the slopes upward to find the summit, or they may follow the brook as it winds back and forth, always progressing to its destination. In each case, the activity aroused in us belongs to the activity involved in the situation. These processes of initiation lead us to action or relaxation. Many paintings of Gothic buildings show a predominance of angular lines, carrying the eye upward by means of buttresses, pinnacles, pointed windows, and spires.

Regardless of how we look at art we project into the art object the response as expressed by individuals. Whether we judge design or color we evaluate it in the light of our own response to it. Since this is the general procedure in arriving at a decision in judging paintings or statuary we need to make inquiry as to just what behavior is involved in making such a choice.

From the findings of experimental laboratories of artists and psychologists it is apparent that artists as individuals or as a class are attempting to arrive at a criterion for judging the adequacy

of artistic creations. Without reviewing the various techniques employed by experts in arriving at a standard for judging art, the author of this study proposes to evaluate the response to art, objects by analyzing the ocular patterns of subjects observing specified designs.

Purpose of the study

The purpose of this study is an attempt to evaluate by means of Ocular Photography the stimulating effects of designs when presented in pairs of observers. It is further an endeavor to find an answer to such questions as:

1. *What relative time do subjects spend on cards when selecting one of two designs regardless of their preference?*

2. *What is the relative excursion frequency of subjects when selecting one of two designs?*

3. *What is the ratio of attention time to excursion frequency when subjects observe designs mounted in the vertical or horizontal plane?*

4. *What elative attention time is devoted to preferred and non-preferred designs according to the judgment of the observers?*

5. *What relative attention time do subjects spend when observing cards in the order of sequence?*
6. *What relative attention time is devoted by subjects on designs when their selection agrees or disagrees with the choice of experts?*

Finally this research study is an attempt to ascertain whether correlations can be established between the so-called laws of color and composition and eye movements.

Procedure

Subjects: Fifty-six subjects, 28 male and 28 female, (college students selected at random) were asked to observe 14 pairs of designs. (The designs are the creation of Maitland Graves which appeared in the August, 1941 issue of the American magazine, pages 96-97 and are described in detail in his book "The Art of Color and Design.")

Exposure cards: Each pair of designs was mounted on a card 5 1/4 x 6 inches with a neutral gray background and presented to each of the 56 subjects with the following instructions:—"Here is a test that will enable you to determine for yourself to what degree you are gifted with good taste. On these cards are 14 pairs of designs. Study each pair carefully and decide which one appeals to you most. Don't be too analytical about it, just pick the one in each pair that strikes you as more unified, better balanced or more appealing than its mate. As soon as you have decided which of the two designs is better record your answer."

The sequence of the cards was rotated so that every card appeared in every position of the series. This procedure was followed in order to eliminate the interest or fatigue factor. The identification numbers used on each pair of designs is identical to the numbers used in the American magazine.

Apparatus: Subjects were photographed with an eye camera illustrated in Fig. 67. This port-

able bidimensional eye camera photographs accurately every eye fixation as well as every movement. The location, duration and sequence of every fixation is obtained by this technique together with the number, direction and distance of the excursions accompanying the fixations.

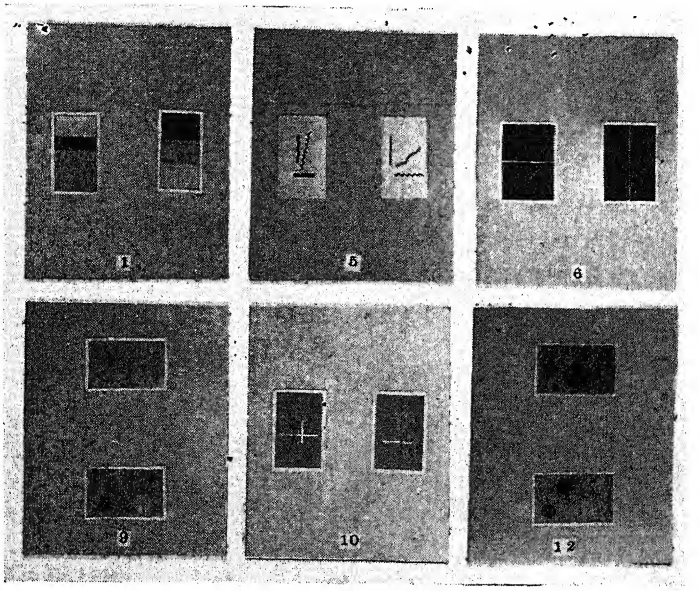


Fig. 66—Six of the fourteen (14) designs observed by fifty si: (56) subjects.

Results

In order to accommodate the reader in obtaining information relative to the general problem of the Laws of Composition and Eye Movements, the author provides the answers based on this study.

1. *What relative time do subjects spend on cards when selecting one of two designs regardless of their preference?*

TABLE XXIV

Relative time subjects spend on cards regardless of preference

Card No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Ave
Male	4.82	4.96	5.27	4.27	4.80	4.00	5.71	4.93	5.41	5.27	5.71	5.27	4.43	4.73	4.97
Famale	3.87	4.86	5.18	5.46	5.71	5.07	5.32	5.78	6.61	5.55	6.86	5.18	5.36	5.32	5.44

* All time is recorded in terms of seconds or a fraction thereof.

Based upon the above table the male subjects spend an average of 4.97 seconds on each of the 14 pairs of designs while the female subjects spend and average of 5.44 seconds while observ-

Fig. 67—Portable eye camera and exposure card.

ing the same cards. This is an average of 5.21 secodns per card for both male and female subjects. It is apparent that female subjects spend more time in making their selection than do male observers.

2. *What is the relative excursion frequency of subjects when selecting one of two designs?*

It seems natural that subjects in selecting one of two designs make excursions from one to the other in an attempt to arrive at a decision. Whether this difference for preference is obvious or concealed to the observer may determine for him the relative number of excursions necessary in making his selection.

TABLE XXV

Relative excursion frequency of subjects observing designs mounted vertically and horizontally.

Card No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Ave
Male	4.50	4.89	5.21	4.57	5 00	4.14	5.32	4.96	5.21	5.89	6.39	4.86	3.93	4.71	4 93
Female	4.29	4.71	5.14	5.57	5.64	5.21	4.71	5.57	5.93	5.54	7.18	4.86	5.00	4.64	5.28

Male subjects according to the above table make an average of 4.93 excursions per card when selecting one of two designs, while female subjects make an average of 5.29 excursions for each card. As in attention time female subjects exceed their male competitors in excursion frequency while making their selection. In computing the relation of attention time to excursion frequency of 4.97 to 4.93 for the males and 5.44 to 5.29 for the female subjects, we arrive at a ratio of 1.00:.99 to 1.00:.97 for the two groups respectively. Female subjects make fewer excursions per unit of time than their male competitors. Both groups make an average of almost one excursion for every second of observation time.

TABLE XXVI

Correlation of attention time and excursion frequency for cards 1-14

Card No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Ave
Av. Att. Time	4.36	4.91	5.22	4.87	5.26	4.54	5.12	5.36	6.02	5 41	6 28	5 22	4.89	5.02	5.21
Av. Exc. Freq.	4 39	4.80	5.18	5.07	5.32	4.68	5.02	5.27	5 57	5.71	6 79	4.86	4.46	4.35	5.11

Subjects spend an average of 5.21 per card and make 5.11 excursions during the same observation time. The correlation between attention time and excursion frequency is .76 all subjects participating.

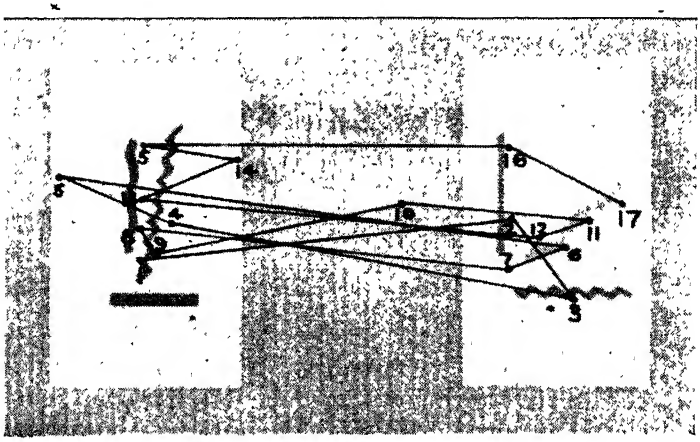


Fig. 68—Ocular pattern of subject 13 observing card No. 14.

Based on the correlation of attention time and excursion frequency it is apparent that whenever more time is spent on a certain card the excursion frequency is increased proportionally. The highest deviation of attention time to excursion frequency is for cards 3, 9 and 12 while a perfect relation exists for cards 1, 5 and 10. Card no. 11 has the highest attention time and excursion frequency while card no. 1 the lowest in both measures of ocular performance.

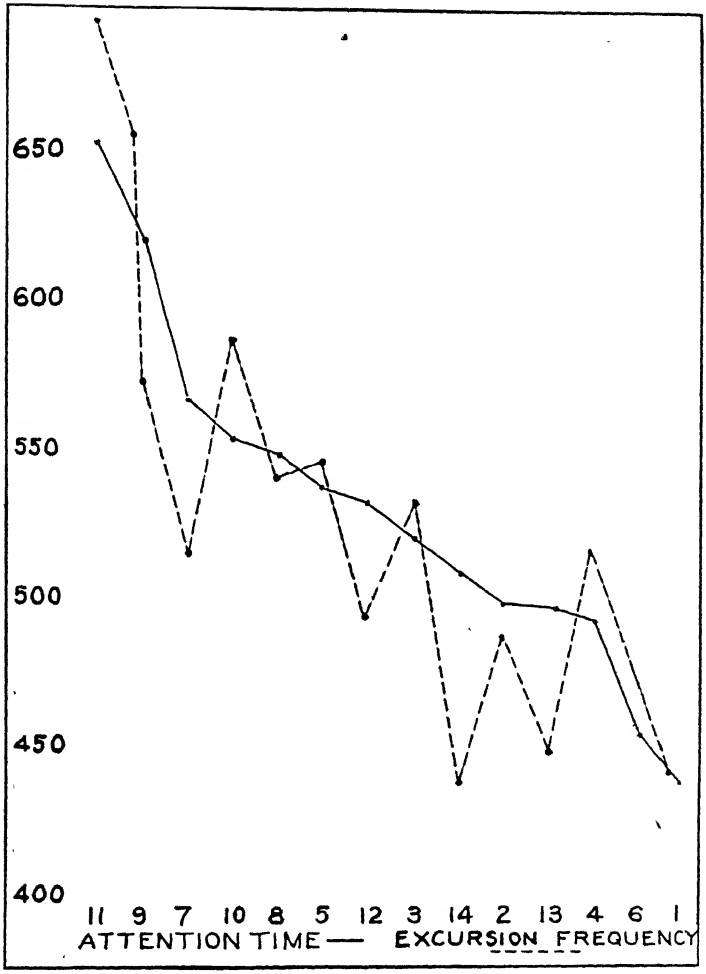


Fig. 69—Relative attention time to excursion frequency.

Figures 68 represents a typical ocular pattern resulting when a subject observes designs with the intention of selecting the one which according to his own judgment of good art is preferred.

3. *What is the ratio of attention time to excursion frequency when subjects observe designs mounted in the vertical or horizontal plane?*

Designs mounted horizontally appear on cards 1, 2, 3, 4, 5, 6, 10 and 11 and designs mounted vertically appear on cards 7, 8, 9, 12, 13 and 14.

TABLE XXVII

Relative excursion frequency of subjects observing designs mounted vertically and horizontally.

Design Mounted	Attention Time	Excursion Frequency	Ratio
Horizontally	5.11	5.24	1.00:1.03
Vertically	5.34	4.92	1.00:.92

The results as tabulated in Table 27 corroborate the findings of earlier studies which revealed that vertical eye movements are inhibited while horizontal ones (other things being equal) are facilitated. More time is spent on cards when observing designs mounted vertically than when such combinations are displayed horizontally. Although observation time is prolonged fewer excursions are executed in the same unit of time.

Figure 69 indicates that considerably fewer excursions were made for designs mounted vertically than those appearing horizontally.

4. *What relative attention time is devoted to preferred and non-preferred designs according to the judgment of the observers?*

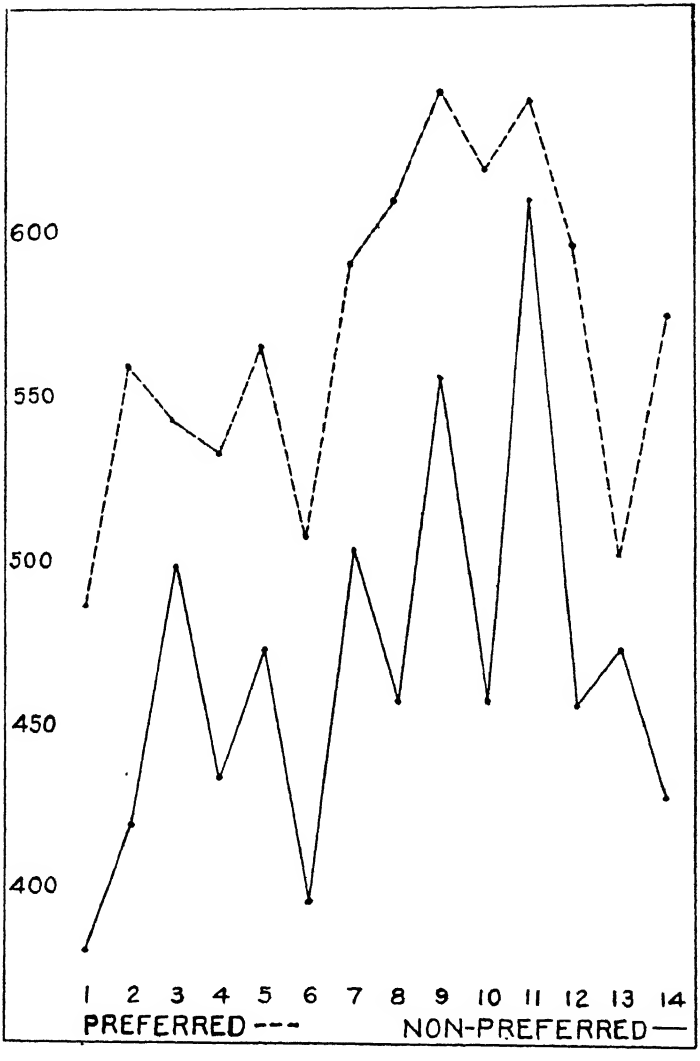


Fig. 70—Attention time of preferred and nonpreferred designs. Card No.

When subjects are requested to select one of two designs it is apparent that a certain attention time is required in order to make such a decision. But in addition it is necessary to obtain information relative to the attention time devoted to preferred and non-preferred designs.

TABLE XXVIII

Relative time spent by subjects on Preferred and Non-preferred designs.

Card No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total Ave
Designs Preferred	4.88	5.61	5.44	5.35	5.67	5.09	5.92	6.11	6.45	6.21	6.43	5 97	5 03	5.76	5.71
Designs Non Pref.	3.83	4.21	5.01	4.35	4.75	3.99	5.11	4.60	5.58	4.21	6.13	4.58	4.75	4 29	4.71

Based upon the results as tabulated in Table xxviii subjects spend and average of 5.71 second on designs preferred while only 4.71 seconds is devoted to designs not preferred by the observer. This difference of attention time for the preferred and non-preferred designs of male and female is 5.51 to 4.43 and 5.90 to 4.98 respectively.

TABLE XXIX

Relative time spent on preferred and non-preferred designs.

Design	M	D	SEM	Md	SEdiff	C.R.
Preferred	159.76	13.55	3.76	28.00	5.74	4.88
Non-Pref.	131.76	16.68	4.63			

Not only is more time spent on designs selected than upon those rejected by the observer but in addition in a much larger number of choices is more time devoted to designs preferred. In only 11 percent of the total number of choices is more time devoted to the non-preferred than to the ones preferred.

5. *What relative attention time do subjects spend when observing cards in the order of sequence?*

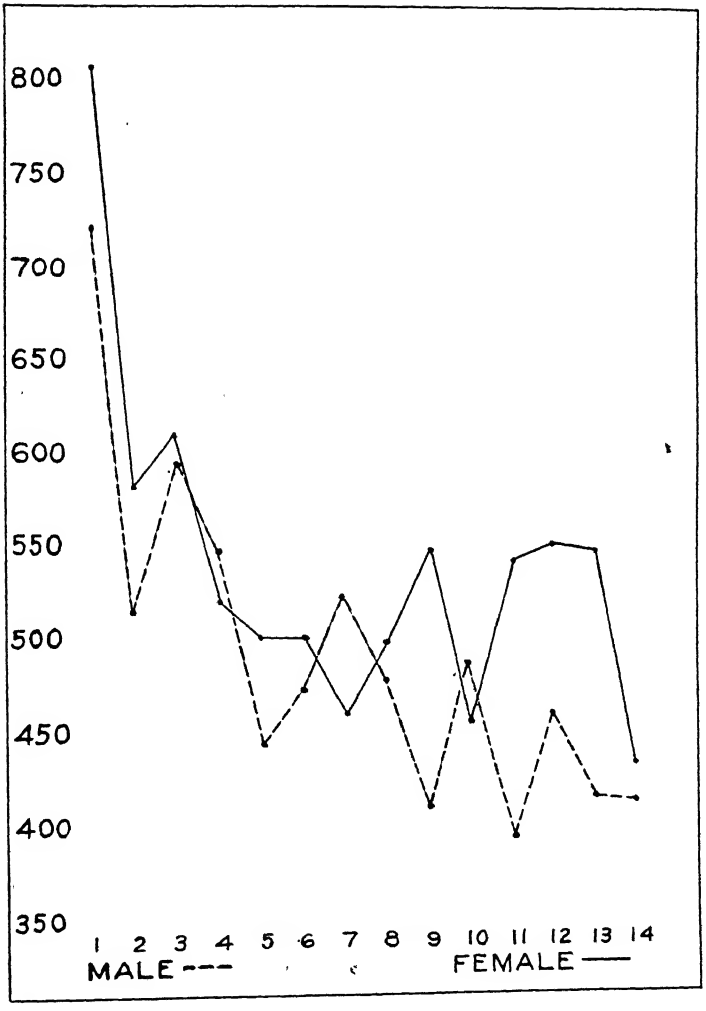


Fig. 71—Attention time of respective cards in order of sequence.

As stated under the caption of procedure, cards were rotated in sequence so that each card appeared in every position of the series. The question which naturally arises is whether subjects spend more time on cards appearing earlier or later in the series.

TABLE XXX

Relative attention time devoted by subjects when observing. 14 exposure cards in order of sequence.

Card Sequence															Total
Card No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Ave
Male	7.29	5.20	5 98	5.52	4.48	4.73	5.27	4.85	4.15	4.91	3.98	4.66	4.21	4.18	4.97
Female	8.10	5.87	6.14	5.23	5.04	5.03	4.66	5.01	5.51	4.61	5.41	5.54	5.51	4.39	5.44

The correlation of attention time and the order of sequence is .80 when attention time of male and female is combined for each position. Figure 71 is a graphic representation of the diminishing attention time devoted to cards appearing later in the series. Male subjects show a greater attention time loss for suceeding exposure cards than do female observers.

6. *What relative attention time is devoted by sujects on designs when their selection agrees or disagrees with the choice of experts?*

Four hundred and sixty five (465) of the seven hundred and eighty four (784) choices of the subjects agree with that of the experts while three hundred and nineteen (319) disagree. Female subjects spend more time in making their selection but a larger number of their choices agree with those of the experts. Both male and female subjects spend significantly less time on designs when their choice agrees with that of the experts.

This might imply that the human mind as eval-

uated by this analysis finds it less difficult to make a choice between two designs when selecting the one which according to experts conforms to fundamental principles of good art.

TABLE XXXI

Attention time of subjects when choice agrees with experts

Subjects	Agrees with Experts		Disagrees with Experts	
	Frequency	Average Time	Frequency	Average Time
Male	223	2.78	169	7.86
Female	242	3.80	150	8.09
M & F	465	3.31	319	7.96

Summary and Conclusions

This study endeavors to discover by means of ocular photography a corrrespondence between the so-called Laws of Color and Designs and Ocular Patterns. It is an attempt to evaluate the art object by scientifically testing the response of individuals to it. Based upon the response of individuals to the art object the author further proposes to provide a criterion for the verification of the adequacy or inadequacy of the observed field.

A number of ocular response patterns together with their psychological implications stand out clearly. One is that the female subjects as a group spend more time when selecting one of two designs. This increased attention time seems to be justified, however, since a larger number of their choices agree with those of experts.

A second phenomenon revealed by this technique is that significantly more time is spent on designs preferred by subjects as compared to designs rejected according to their own judgment. This conclusion seems logical due to the fact that human nature desires to retain or sustain

what is satisfying and dispel or discontinue as soon as possible that which is dissatisfying. The neural hypothesis theory contends that the readiness of the nervous system determines for an individual the degree of satisfaction which accompanies such an act.

In computing the relative excursions made by subjects when observing designs mounted vertically or horizontally it is apparent that significantly more excursions are made when the eye is permitted to move laterally. This might imply that less aesthetical satisfaction accompanies an ocular performance when an excess of vertical eye movements is necessitated due to the character of the composition.

It is noteworthy that the attention of subjects observing respective exposure cards is consistently longer for cards presented earlier in the series than those observed later. This would imply that a certain degree of fatigue or loss of interest operates. Cards seen first are accorded a longer observation time than those appearing later in the series. This is apparent especially for the first four cards of the series. The diminishing attention time for subsequent exposure cards is less pronounced for female than for male observers. Attention is diminished considerably when observing fourteen exposure cards but just how much attention time would be reduced by exposing additional cards can not be ascertained by the results of this study.

Another interesting discovery made by this study is that significantly less time is devoted to designs selected by the observer in agreement with those selected by experts.

Graves in his study designates designs preferred by artists. This study reveals that the average layman prefers a larger number of designs (465) in agreement with experts than those that are non-preferred, (319) by such authorities.

Just why observers should devote less time to designs preferred by both the artist and layman is not clear at this time. The only possible explanation the author proposes is that the difference was sufficiently obvious that little time was required to arrive at a decision.

When speaking of the psychology of art we are no longer thinking in abstract terms when employing Ocular Photography as a Scientific Approach to the study of Color and Composition. If the principle known as the golden mean with a ration of 1.68:1.00 is considered more adequate than other proportions and if certain colors are positive, aggressive, relieving or tranquil and if balance, variety, dominance or unity seems to be inherent then it seems feasible that the unconscious reaction of the eyes is reflected in ocular patterns resulting. Based upon such implications it is likely that the behavior of the eye constitutes the final court of appeal in ascertaining the adequacy or inadequacy of a composition.

It is likely that original responses to color and composition are as natural as our response to salt and sugar. It is, however, expected that experience and association especially of the earlier years have a definite effect upon our response to the field of observation.

If this approach to the study of art will aid in a more adequate creation of it, we have much to expect from ocular photography as a technique in evaluating the why of color and design.

Color preference: Two main purposes prompted the experiment on color preference. One was to learn whether more time was devoted to the color selected than to the one rejected when two colors were exposed simultaneously; the other was to discover whether more time was devoted in selecting one of two complementary or antagonistic colors.

Four basic colors—red, green, blue and yellow—were selected for the experiment. These were presented to each of thirty subjects in six combinations. The sequence was changed for every subject in order to eliminate preference for earlier and later exposures.

Subjects were instructed to select one of each pair of colors they preferred most by reporting right or left. Although the experimenters were not especially interested in the selection of colors, subjects indicated their preference for the 180 possible as follows: red, 69; yellow, 40; blue, 38; and green 33. In 72.85 percent of the total choices more time was spent on the preferred colors.

Complementary colors as here designated were red-green and blue-yellow, while the antagonistic colors were identified as red-blue, red-yellow, green-blue and green-yellow. Based on this classification, subjects spent a total of 115.38 seconds in selecting one of two antagonistic colors while only a total of 95.25 seconds were devoted to choosing one of the complementary colors. This difference, although fairly constant, has a critical ratio of only 1.42. This may be due to the fact that the colors were not truly classified as antagonistic and complementary and that the choice of colors was not 100 percent correct on the basis of color tone, tint or saturation.

With a larger sample and correctly selected colors, it is likely that more time is spent when choosing one of two antagonistic colors than when selecting one of two which are complementary. It may be agreed that complementary colors are more easily discriminated on this score since they are on the opposite sides of a color wheel, and hence provide greater contrast. Female subjects, as in the selecting of designs, spent 3.87 seconds to make their selection while male subjects spent only 3.40 seconds.

Pictures: Fig. 72 illustrates the relative time spent by 50 subjects in observing two pictures, one a battle scene and the other a peaceful country scene. The difference is in the ratio of 2:1 in favor of the battle scene.

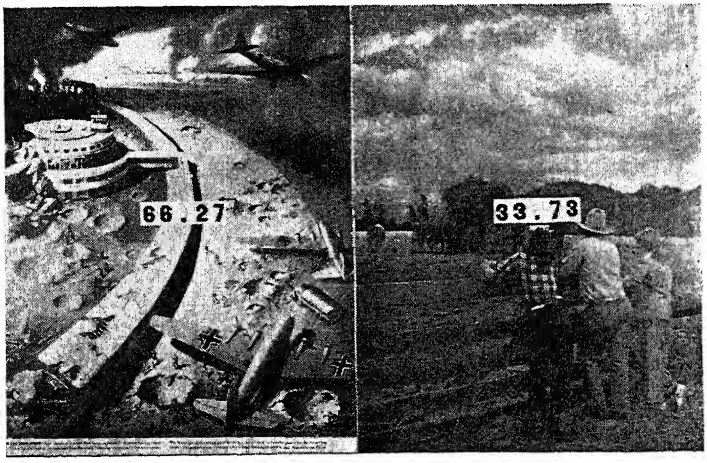


Fig. 72—Subjects observed these two scenes in this and reversed positions.

The reason for the attentional advantage of the war scene may be due to our present conflict, or to the fact that people prefer action or that the lines are fascinating. (Position of pictures were reversed for 50 per cent of the subjects.)

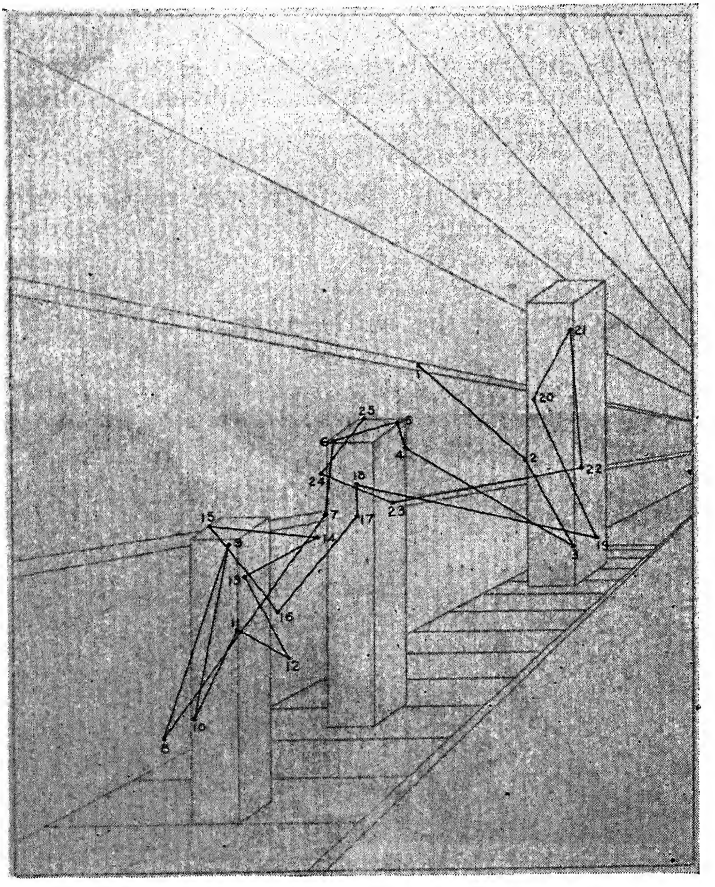


Fig. 73—Subject observes the three objects in the picture and decides the pillar farthest away is the tallest.

AESTHETIC APPRECIATION

Just what aesthetic appreciation may be and what is responsible for such an experience may never be known, but the author is of the opinion that the actual movements of the eye contribute their share to the satisfaction accompanying the observation of a picture or an art object.

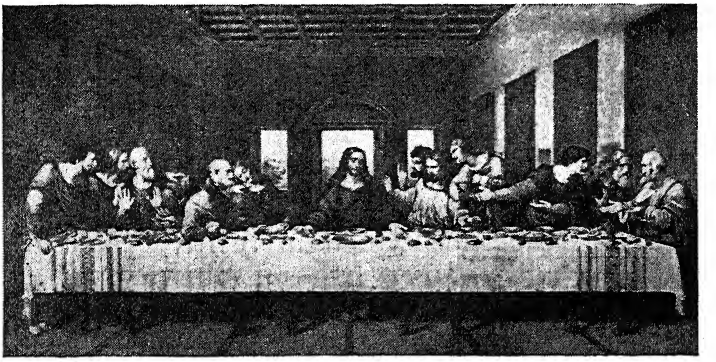


Fig. 74—The Last Supper.

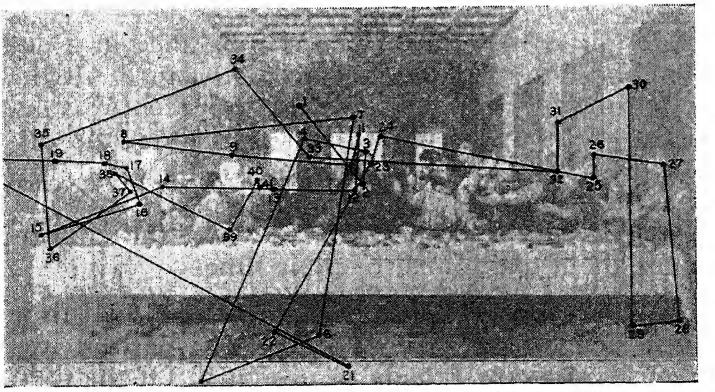


Fig. 75—Non-artist looks at picture.

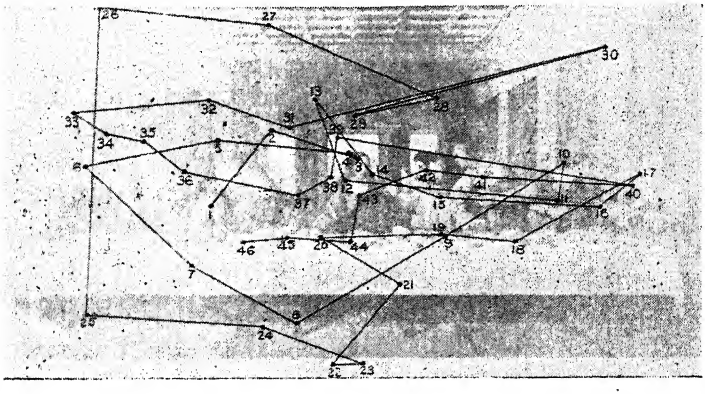


Fig. 76—Artist looks at picture.

Balance: To discover what people do when they look at designs that are balanced or imbalanced is a question which in reality cannot be answered unless observers are subjected to an objective test. Ten subjects were selected to look for ten seconds (exposure time unknown to subject) at the two designs illustrated in Fig. 77 and Fig. 78. Figures were observed in succession by alternating their sequence each successive observation.

Design A is an example of imbalance in a design and design B is a balanced structure. Of the total time spent on design A 24.37 percent was devoted to the upper right hand area above the pillar. Just what explanation can be made for this concentration of fixation at this point is not our problem, except to know that is where the subjects spent about one-fourth of their time.

Subjects devoted 34.37 percent of the total time outside of design A while only 17.75 percent was spent by subjects outside of design B. Of the total time devoted to the pillar of A and B, 31.28 per-

cent and 30.58 percent was spent on each respectively. It is likely that the other elements of the design such as line, shape, proportion, etc., could be evaluated by this same technique.

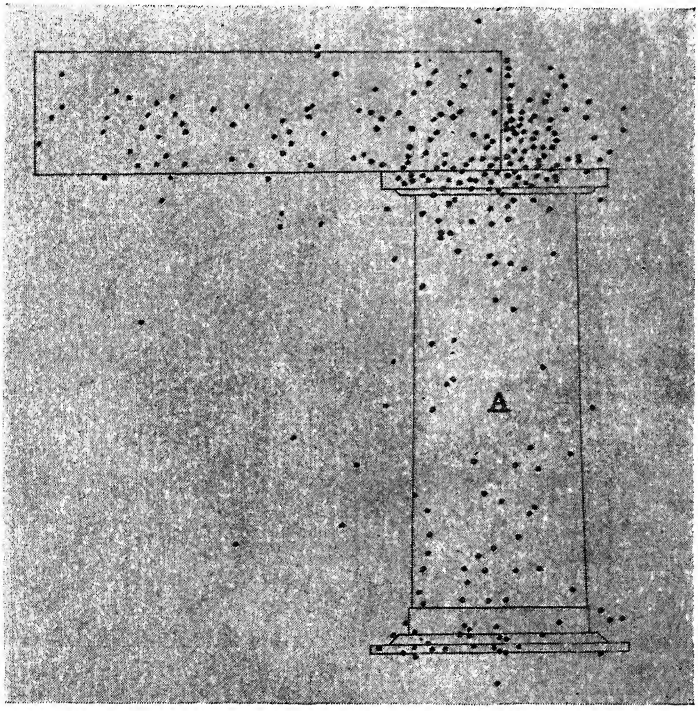


Fig 77—Imbalanced design.

Just how much of what we call aesthetics is due to native drives, and hence, prompted by organic urges and how much is due to acquired behavior tendencies is not known. At any rate, the behavior of an individual toward an art ob-

ject seems to be our best objective cue to his experience in the situation. Note the increased time in percent at point of arrow.

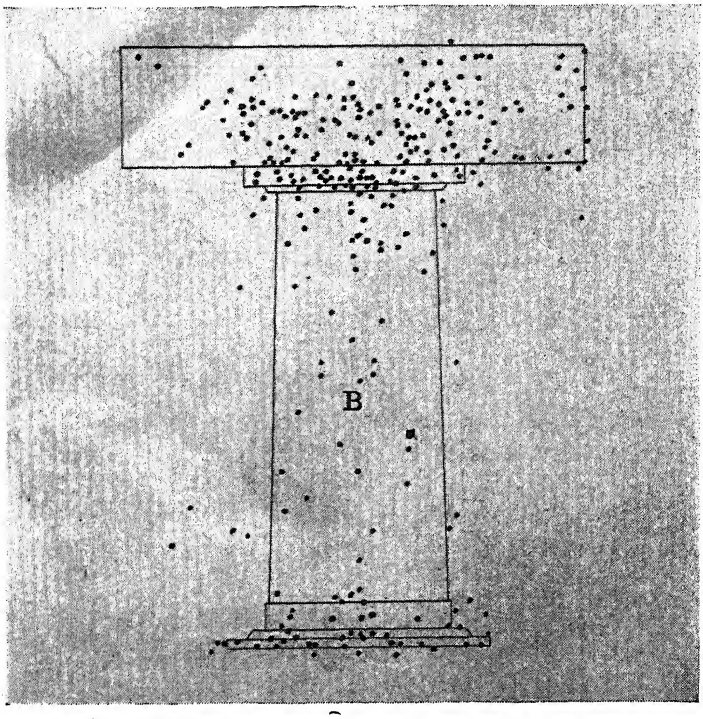


Fig. 78—Balanced design with fixation density.

The great painter who is able to elicit intense aesthetic experience in the observer needs, of necessity, to employ the aforementioned principles in order that he may gain for himself the desired end. This emphasis does not in any way discredit such projectional influence as association and empathy which are essential for effectiveness in the creation and appreciation of art, but

it calls attention to the subtle devices employed by the artist to establish mediums for the direction of the eyes from point to point. The writer

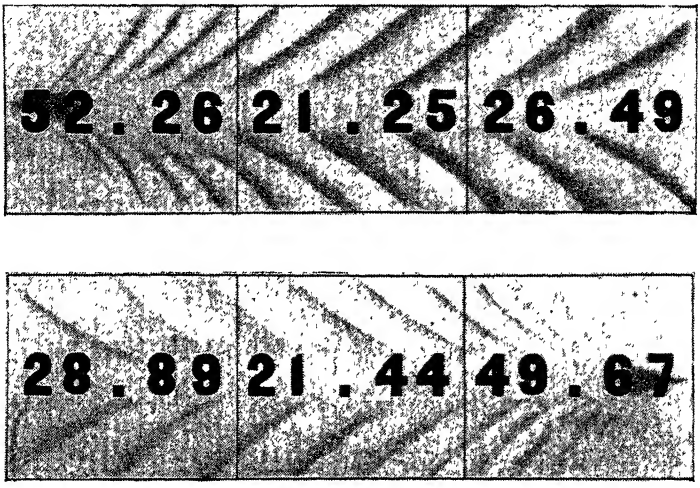


Fig. 79—Relative time spent on different portions of an arrow design.

does not mean to imply that analysis of ocular performance alone will yield the necessary information regarding psychological processes involved in art appreciation. He does, however, contend that such procedure will throw new light on many of its underlying laws now vaguely understood and interpreted.

Ocular performance is determined by certain field forces (a term borowed from Gestalt Psychology) both attracting or repelling, as the case may be. The organism seeks and retains what it likes, and avoids and rejects what it dislikes. We are thus neurally equipped with unconscious drives and inhibitions which determine for us what we will or will not do. This may be ex-

pressed in a passive or active response to a situation. Coupled with these two alternatives is a third which is best described as a conflict between two compelling drives for action.

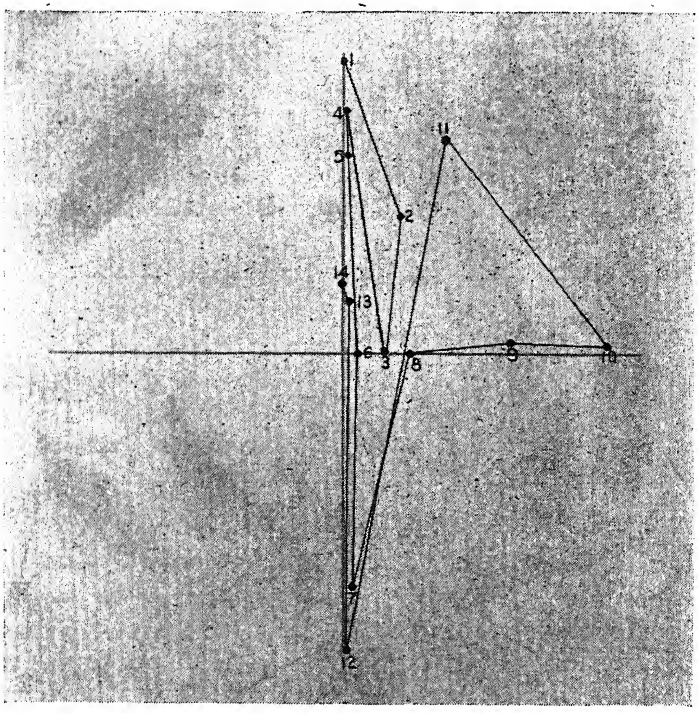


Fig. 80—Ocular pattern of subject attempting to determine whether the horizontal and vertical lines are equal in length.

Beauty, as we experience it, is not a thing; it is simply a product of behavior. Whatever we deem beautiful must have value, and, naturally, our response to it will give evidence of the value we attach to the object of appreciation. With this general point of view it becomes apparent that any phase of life can hold for an individual varying degrees of the beautiful.

PART VII

OCULAR PATTERNS AND THEIR PSYCHOLOGICAL IMPLICATIONS

Ocular patterns properly recorded and analyzed imply numerous psychological concepts. Many central processes reveal their characteristics when subjected to this form of analysis.

Attention: To see is to look but to look does not guarantee seeing. Seeing, as pointed out earlier, is after all a mental process, and only by responding to what we have observed do we experience what is known as perception. Every ocular pattern is a record of where a subject looked. Just what he saw cannot be discovered even if the subject is required to answer questions about the scene or to recall the main items of a given situation. This is not necessarily a limitation in psychological research. All other sciences have even less subjective information on which to base their objective evaluation.

Attention, as revealed by ocular performance, simply implies that the point where the fixations of a group are densest the attention was attracted. Whether this concentration was due to the physical stimuli, the intention, or the habit patterns of the observer, makes little difference for our purpose of evaluating attention. Our task is to discover to what extent attention was attracted to certain areas, and by varying the stimulus and purpose and habits of the observer we can determine even the relative influence of these factors.

Individual differences as expressed in the ability to attend are probably as great as any of the mental processes in human adjustment. The type of attention we employ may serve as a criterion or measure of our efficiency in executing everyday tasks and obligations. Distraction in the true sense of the word is attention par excellence. It is just this kind of attention which is termed involuntary and which in ordinary life plays a definite role in the activities of individuals. Children and immature adults are greatly influenced by this kind of stimulation. Fig. 83 is a crude illustration of this principle.

Consciousness is not uniform. Its center is relatively clear while the margin is indefinite and vague, and the more intensely the center of a given field is focused, the more sketchy and obscure will the outer fringe become. During intensive concentration, one group of impressions becomes exeedingly clear while others fall into obscurity. This process continues as an individual observes a picture or landscape until the entire field has been examined.

Attention is fundamentally a change in the clearness of some phase or aspect of a mental process. Some of the characteristics of attention revealed by experimental psychology clearly indicate that attention is always active, very selective, exceedingly mobile, and highly conscious. To verify the above statement one needs only to examine a few ocular patterns and it becomes apparent that there is no such thing as an inactive or passive attention. Attention seems to be a natural mental process. At any rate, we do not teach children to attend; our major task as

educators is to teach them how and to what to attend.

DETERMINERS OF ATTENTION

Attention, regardless of where we observe it, is fundamentally the same. It is identified and evaluated good or bad, effective or ineffective, depending upon the use we make of it. Attention, just as merchandise, comes in different packages or kinds or brands. For our purpose we shall describe three brands to be identified by the names involuntary, or primary; voluntary or purposed; and non-voluntary or habitual attention.

Involuntary or primary: Involuntary attention is the type of attention commonly engaged in by children. It is largely determined by the nature of the environment or external forces such as bright colors, the size of objects, the intensity of the stimulus, and the repetition or novelty of the thing observed. This brand of attention may pass for distraction in the environment, but as already stated, the distraction is "attention par excellence".

Advertising, as we know it today, is utilizing this type of attention when color, size, and novelty are employed to catch the attention of the reader. This brand of attention is often more potent in getting attention than in sustaining it. A large part of advertising layout is constructed with the idea of catching the attention of the reader. This is primarily because the advertiser knows he must get the attention before he can expect the reader to devote additional time to reading the message.

Voluntary or purposed: Voluntary attention is the brand employed in executing a new or varied task. If one asks an individual to check all the letter "a's" on a certain page, he is practically blind to all others letters of the alphabet on that page. In many cases the task of the individual and distraction or interesting stimuli, present themselves simultaneously and thus result in a conflict of two brands of attention. The one brand appeals to the senses in terms of freedom and enjoyment, the other makes its appeals on the basis of purpose or duty.

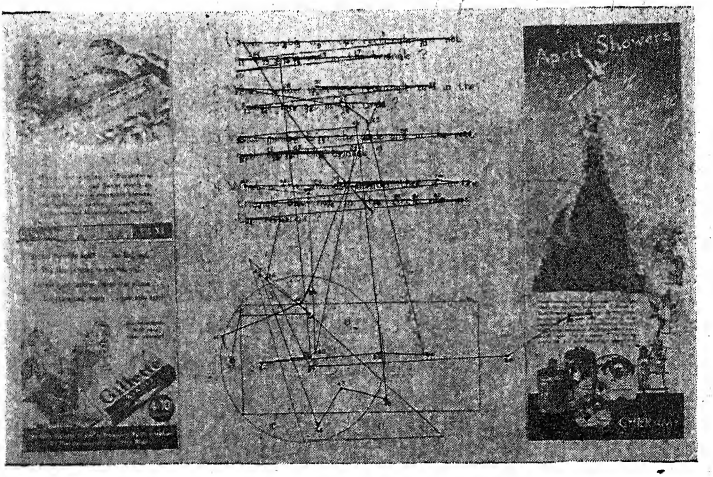


Fig. 81—An ocular pattern illustrating purposed or voluntary attention.

The above illustration is an example of the conflict between two types of attention common to everyday life. It is obvious that individuals observed in the problem would find little occasion to observe whatever was irrelevant or un-

related to the task in mind. Based on this type of objective measure, the relative abilities, interest, and accomplishments can be evaluated for the individuals so subjected. The subject attempting answers to his problem in Fig. 81 evidenced a high degree of voluntary attention, while the subject observing the same field in Fig. 82 reveals that the physical field was a decided distraction for him.

The efficiency with which voluntary attention is employed depends to a large extent upon the training and ability of the observer and the value attached to the task he is performing.

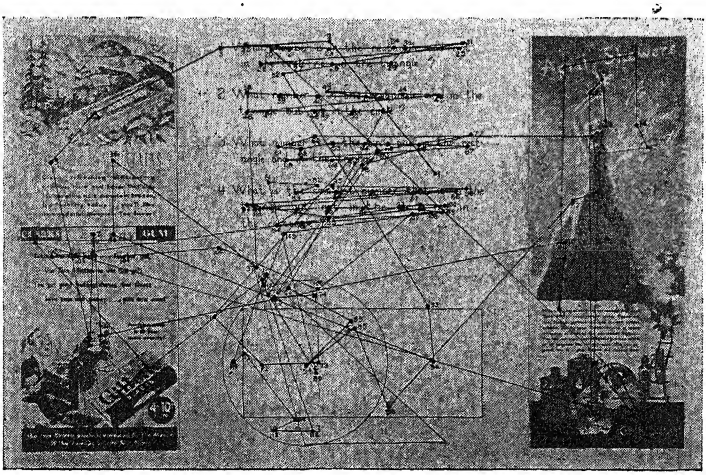


Fig. 82—An ocular pattern illustrating the influence of voluntary and involuntary attention.

Although distraction in schools and industry should be reduced to a minimum, one of the most important factors underlying sustained attention is the degree to which the individual employs voluntary or directed attention.

Non-voluntary or habitual attention: Non-voluntary attention is a brand earned in the market of hard knocks. It is the type which results after years of association and experience in a certain field of vocation. The hairdresser, the mechanic, the advertiser, each in his own way, observes those things which are and have been important to him. He exerts little if any effort to keep his mind on it for it is his meat and drink. It is the field in which he is interested, in which he gets satisfaction.

The non-voluntary type of attention is the most efficient form of mental activity since little concious effort is required to sustain it. Efficiency and satisfaction in our work is a measure of how consistently we employ this non-voluntary brand of mental activity.

Regardless of which of the three brands of attention we employ or what combination we enjoy, ocular patterns if properly analyzed speak a graphic language of psychological processes underlying attentive behavior.

Perception: Probably no topic in psychology has provided more cause for research and discussion than has that of perception. This is not surprising since all of our knowledge is based upon the interpretation and understanding of our environment. Consequently, this mental process, is highly significant for all of our adjustments. As stated earlier, not all that strikes the optic nerves is interpreted by the human mind. In reality we respond to only a very small part of the environment in which we live, and even then our response is limited by the experience we have had with it.

Lines and curves of a drawing have meaning only when we have sufficient experience to support the idea which lies back of them. This is strictly true in symbols of reading and mathematics. If experience has preceded, the imaginary pictures are readily supplied, without such contrasts, associations are nil and the symbols remain black dots on white paper.

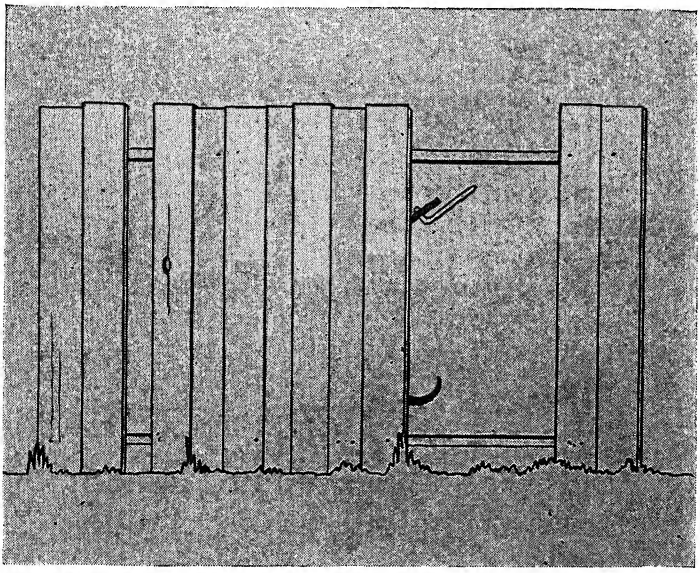


Fig. 83—Do these horizontal and vertical lines make sense to you?

Organization and assimilation of the otherwise disconnected objects, lines, spheres and colors finds a place in thinking purely as a creation of the individual looking at them. Ideas do not exist except as the mind creates them out of the otherwise chaotic situation. The illustra-

tion in Fig. 83 may constitute only so many lines to one who cannot with his imagination complete the picture. But to one who sees a boy marching with a gun over his shoulder and his dog beside him, the lines begin to make sense.

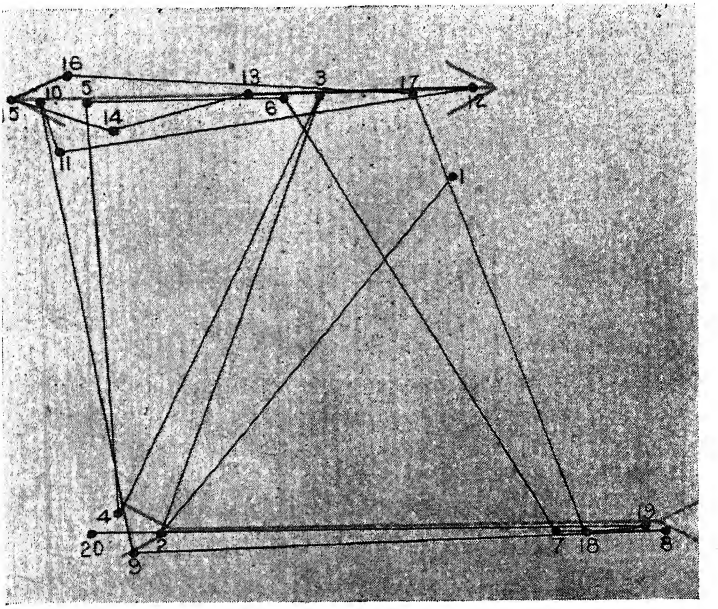


Fig. 84—Subject attempting to judge which of the two lines is longer.

Fig. 85 Subject after looking at the hat for a few seconds decided that the hat was taller than it was wide.

Illusions are exceedingly common in everyday life. Some are recognized as such and behavior is modified accordingly, while others are accepted and responded as though they were reality.

Illusions are of particular interest to artists,

architects, printers, and camouflage experts. To deceive or make real when the situations is fictitious is an art of experts in many fields. Marble walls or solid oak doors may only be substitutes but may produce the same effect as the product they represent.

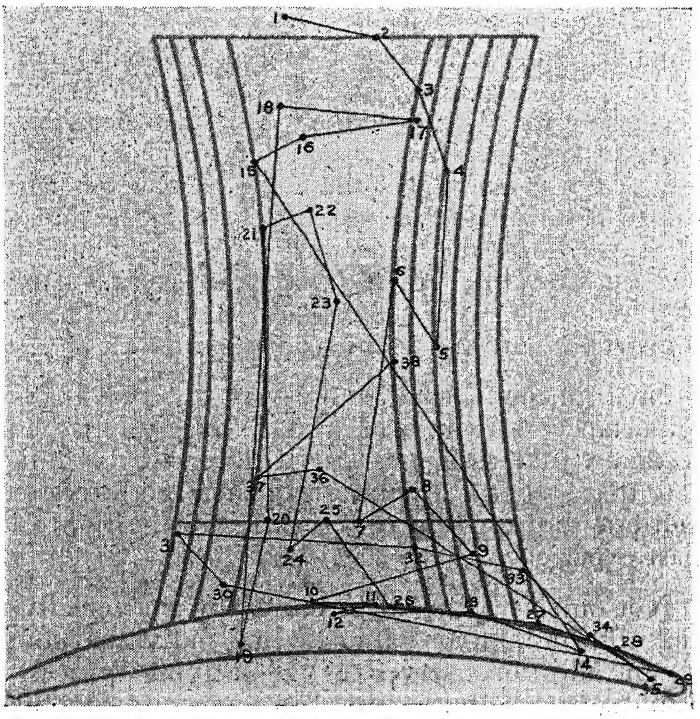


Fig. 85—Subject after looking at the hat for a few seconds decided that the hat was taller than it was wide.

Ocular performance properly evaluated may reveal the why or correct and incorrect interpretation of stimuli and provide a basis for aesthetic experiences accompanying the eyes in motion.

Habits: Our eyes are essentially compensatory devices, and do not, as is commonly believed, collect and transmit accurate indicies of the energy changes in the external environment. There is no one-to-one relationship between the neural response and the physcial events that produce them.

The eyes are too often looked upon as cameras photographing whatever is exposed to them. Quite to the contrary, the retina, which is the photographic plate of the eye, suppresses certain portions of the sensitive cell area and enhances others. To illustrate the above phenomenon would be to imagine a picture painted on a large plastic. Due to the selective process of attention, interest, and interpretation, certain areas of the observed field would rise and others would recede, representing a relief map in motion.

This phenomenon in no way discounts the importance of physical stimuli to give rise to certain visual responses but it does clearly indicate that seeing is a habit and hence reinforces or inhibits the response to light rays in the light of past experience.

Not only is seeing determined by the selective and discriminating habits of an individual but it, in addition, serves as a unifying process. Simultaneously with impulses coming from the eyes to the brain to discharge their message, impulses from other senses (ears, muscles, joints, and skin) relay their respective reports. The aggregate of these mental components does not seem to confuse the issue but rather terminate in a unitary response. The art of seeing, as such, is not a single response to retinal stimuli, but is contingent upon and modified by other

sensory and motor processes. What we see as response to stimuli is not determined so much by the physical stimuli that meet the eye as by what we do about it. Seeing is habitual and is the result of practice and training. It is in this respect no different from any of the other acquired skills of our hands, tongue, or feet.

If the mind responds to more than meets the eye and if it never responds to but a portion of what is reflected in the retina, it follows that perception or the interpretation of the stimuli is an act based upon acquired ocular skills. Past experience in seeing thus provides a dynamic or motor basis for the present seeing adjustment and as a result of the action patterns rather than visual impressions determine the art of seeing. Stimuli and sensory processes are the means to an end, while the action pattern constitutes the end known as Seeing.

As stated elsewhere in this volume, if seeing is an attempt to unify or organize the stimuli into an integrated, meaningful whole, it becomes apparent that the action pattern is fundamental in reproducing a meaningful response. It is likely that the same light stimuli reflected from objects strike the young child's retina which are present in the adult observer, but it is apparent that the adult's response to these identical stimuli is decidedly different. This difference is due not to stimuli as such but to action patterns which have become habitual.

If learning and retention are based upon the organization of perceived data, it becomes evident that the action pattern is fundamental in the process and that ocular performance may be symptomatic of such a creation.

Seeing, then, as a form of perception is essentially a motor rather than a sensory function. This does not imply that stimuli or sensory responses to stimuli are insignificant or dispensible. It simply means that the acquisition of a certain action pattern is the basis for efficient seing.

Seeing, interpreted as the habitual action pattern of the mind, or nervous system, presupposes a selection-rejection of certain stimuli of an exposed field. This is evident when analyzing our response to the lines in Fig. 85., which as a result of our new interpretation changed in structure and relationship.

If seeing is determined by action patterns and if these patterns may be fashioned by training like other human skills, it behooves us to evaluate by means of photography the ocular patterns symptomatic of the neural organization.

Interest: Interest as revealed by ocular patterns is characterized by the concentration of fixations in a certain area as well as the sequence and direction of the excursions. These areas of concentration may be few or numerous in a single picture or advertisement, but the ocular patterns reveals centers of interest and the nature of the perceptual response far better than could be expected from the verbalization of the individual. Center of interest and attention may then be located and recorded objectively for future reference and comparison.

Proceding on the assumption that interests are symptoms of abilities, it is likely that aptitude tests can be devised employing ocular photography to determine certain vocational interests and aptitudes of individuals. If interests are

symptoms of abilities and we intend attend to that which interests us, it seems feasible that certain abilities could be discovered by means of ocular photography. Interest and attention are coextensive in that they constitute the experience itself. Schools and industries must ultimately reckon with this human attribute, and if the scientific study of ocular performance will throw light on this vital phase of human adjustment, this technique known as ocular photography will have served a valuable end.

Based on the results of the studies reported earlier, it is clear that a subject will spend more time on those objects in which he or she may be interested. To evaluate and announce our own interests is in most cases impractical and unsound. It may in many cases yield preferences which are supported by rationalization or a type of justification for a choice and which, in reality, are not truly representations of the real unconscious tendencies.

Since interest presupposes previous experience in terms of information, a degree of familiarity, a sense of satisfaction, or a feeling of worth and advantage, unconsciously expressed, an inherent set of likes and dislikes and an active effort to respond to respective situations are implied. Ocular photography may be the logical approach to the scientific study of this important problem of human adjustment. Interests are not superficial but are based upon a neural organization which owes its source to native capacity as well as to acquired habit patterns of the individual.

The degree to which these interests may be discovered will depend largely upon the adequa-

cy of the design of the experiment itself. To know that human interests exist and to discover to what degree they function is to create a physical setting in which individuals have an opportunity to express their preference and thus objectively be measured and evaluated.

It is likely that by means of this approach we shall be able to discover clerical, mechanical, social and art abilities of human individuals which will predetermine the type of training necessary, as well as the selection of a vocation properly adapted to the respective interests, capacities, and abilities of professional and non-professional men and women. Such ocular patterns may constitute a graphic representation of human inclinations and desires, and, if properly attained, yield valuable information for teachers, parents, and vocations counselors alike.

To be able to detect an aptitude is the challenge of every generation, especially if it expects to do something about it. If aptitudes can be discovered, correct training given, and the right vocation selected, that may be called an accomplishment. Knowing the importance of the correct evaluation of this phase of human life, educators and personnel managers are eager to find a method which may aid them in accomplishing this purpose.

Again, without taking stock of the variety of instruments that have been developed for the purpose of discovering aptitudes of individuals, the author is of the opinion that certain aptitudes may be revealed by evaluating the ocular performance of the individual. This, he believes, can be achieved by discovering the unconscious and unknown desires of the individual when

subjected to certain types of performance essential in respective tasks and vocations.

Individual differences: The discovery of individual differences is probably the greatest contribution of scientific psychology.

Of all the ocular patterns recorded no two are alike. This is not strange, for it corresponds to the diversities of comparing handwriting or speech of an equal number of individuals. Science, however, builds on similarities and needs to discover in what way individuals are alike in order that methods of procedure may be devised which apply to basic forms of behavior. For this reason the word average or norm has come in for a good deal of speculation and application in attempting a description, a prediction, or certain controls of human conduct.

To discover how we are all alike is to know how to set a stage which will reveal the uniformity of conduct. This applies to the painter who by means of color and design obtains a common response, the advertiser who prepares his copy to catch and sustain attention and the average man or woman in industry.

Even industry cannot afford to overlook this principle of ocular performance since time and motion play a significant role in all of the activities necessary for efficient workmanship.

Ocular photography has clearly illustrated that, although every eye movement pattern is different in terms of the duration, location, and frequency of fixations, and that every excursion distance and direction represents a unique individuality, ocular patterns are sufficiently alike that certain psychological laws may be formulated.

PART VIII

PROJECTED STUDIES AND THEIR APPLICATIONS

After analyzing the ocular patterns of thousands of subjects, the author is convinced that we have barely tapped the sources of psychological information revealed by the ocular performance of the human eyes.

In addition to the findings of such major fields as advertising, learning, and art, the author postulates that by means of this technique we will be able to:

Measure the intellectual abilities of individuals,
Ascertain the aptitudes underlying mental and motor- performance,
Establish criteria in judging the degree of intoxication,
Differentiate between the abilities of poor and good gunners,
Evaluate the adequacy or inadequacy,
Diagnose visual acuity in relation to the task to be performed,
Determine the effect of fatigue resulting from prolonged motor activity.
Detect the guilt or innocence of a criminal, and identify specific personality traits and characteristics.

Visual acuity: To see is to perceive and interpret whatever is observed. The optometrist who can fashion for his patient a clear and more accurate image is without a dòubt assisting the psychological processes involved. If due to the

corrections his patient can read more rapidly, perceive more accurately and learn more adequately, he may consider himself a psychologist who is in a position to facilitate mental psychological processes. An optometrist besides being a refractionist may well consider his work a necessary link in the whole scheme of educational effectiveness, industrial efficiency, personality development, and social integration.

Innumerable reports from teachers and parents indicate the change and improved behavior due to corrected vision. This is not at all surprising since most of our mental imagery is visual in character and deficiency of this avenue deprives a subject of the major portion of his mental content.

In reality, we do not see with our eyes. These provide only an avenue for sensory experience which becomes reality as a result of the interpretations of the human mind. This is the material which constitutes the real seeing content. Only after the sensory experience has passed these stages is it ready for practical consumption.

To aid the mind at work is to follow through with procedures far in advance of fitting ophthalmic lenses. It is a means of aiding the intricate nervous system in complicated mental adjustment processes and to equip the individual with enriched visual experience which will flower in education and industrial efficiency and a well rounded personality.

The modern optrometrist will confirm, if at all possible, the condition under which his patient works He will want to make certain what visual skills are demanded of him and whether night vision or daylight vision is de-

manded. Does the job require depth perception, pursuit movements, near vision, detailed discrimination or exploratory observation? To make an ophthalmic correction without determining, at least to a degree, the visual motor requirements of the patient so treated is like providing a man with a gun without any consideration of what he expects to shoot.

To observe the ocular performance of an individual with defective vision by means of ocular photography before and after correction may be a unique revelation. To see a permanent record of an ocular performance before and after refraction might reveal to the oculist certain information necessary to use as a scientific practice.

Optometry as a science of seeing is destined to join hands with psychology in its quest for a solution to efficient and effective ocular performance. For an optometrist to see beyond the mere visual mechanism known as the human eye and to study its behavior in the light of adjustment with a purpose, is to see the mind at work.

Illumination: In all activities, whether motor or mental, proper illumination (intensity and distribution) is a first prerequisite. Today, as never before in the history of civilized man, is proper illumination a condition of highest importance. First, because the activities engaged in, whether office, school, or industry, are indoors tasks, and require an abundance of artificial illumination. Secondly, fast moving machines on highways and in industry demand more and better light. Thirdly, production today demands measurements of precision and therefore accurate

and efficient observation. And finally, industrial plants are in operation not eight or sixteen, but twenty-four hours per day. Light and better light is the slogan in the fourfold demand of society.

Attention, discrimination, perception, judgment, and adjustment function most effectively when the condition of illumination are correct. The psychological approach to the study of adequate illumination is imperative, first because problems of illumination are psychological as well as physical or physiological, and secondly, because an illumination engineer without an adequate concept of the physical and psychological demands underlying ocular performance is not equipped to cope with his responsibility.

A lighting expert, be he an architect, a mechanic, or a salesman, has problems other than illumination. For him to provide adequate light implies increased efficiency, a reduction of accidents and minimized fatigue. To aid the mind at work is to follow thru with lighting procedures far in advance of hanging lighting fixtures. Adequate illumination, whether in industry, home, school, or office, bears dividends in terms of mental hygiene and personal satisfaction.

Even if seeing is a physiological phenomenon affected by physical conditions, it is nevertheless a psychological process in operation. To see is to perceive and interpret whatever is observed, and the lighting engineer who can provide, by his technique, clear, distinct, and accurate images, is without a doubt assisting the psychological processes involved.

Based upon these principles, lighting engineers may well take note of the ocular performance

when measuring by lighting varations in the selection and installation of proper illumination.

Crime detection: Among the common or uncommon techniques employed to detect the guilt or secrets of a criminal, certain of the following methods have been employed to obtain a confession: circumstantial evidence, the association test, physiological changes, blood pressure tests, the psychogalvanic reflex, brain wave methods, and ocular photography—since our eyes adjust unconsciously in whatever we attempt to do and since adjustments in crime situations are essentially the same, it would seem only reasonable that deception or concealing of certain information would be readily detected.

As a preliminary test to verify this above assumption twenty-five subjects were selected to look at a card on which were mounted nine playing cards. Each subject was instructed to select a card and look at it with the intention of reproducing it later. This he did while his eye movements were photographed. After the selection of the card, the subject reproduced from memory the symbols on the playing card and placed the reproduction in an envelope with his signature.

All of the twenty-five cards selected were correctly indentified without opening the envelopes after their ocular patterns were reproduced; and it was found that the subject spent an average of 10.90 seconds on the card he selected and an average of 3.82 seconds on each of the other eight cards not selected. Subjects spent 74.05 percent of the total time on cards selected for reproduction, while only 25.95 percent was de-

voted to cards not selected. When questioned why he spent the major portion of his time observing the nine of hearts he said, "I forgot whether all the hearts were turned up or down."

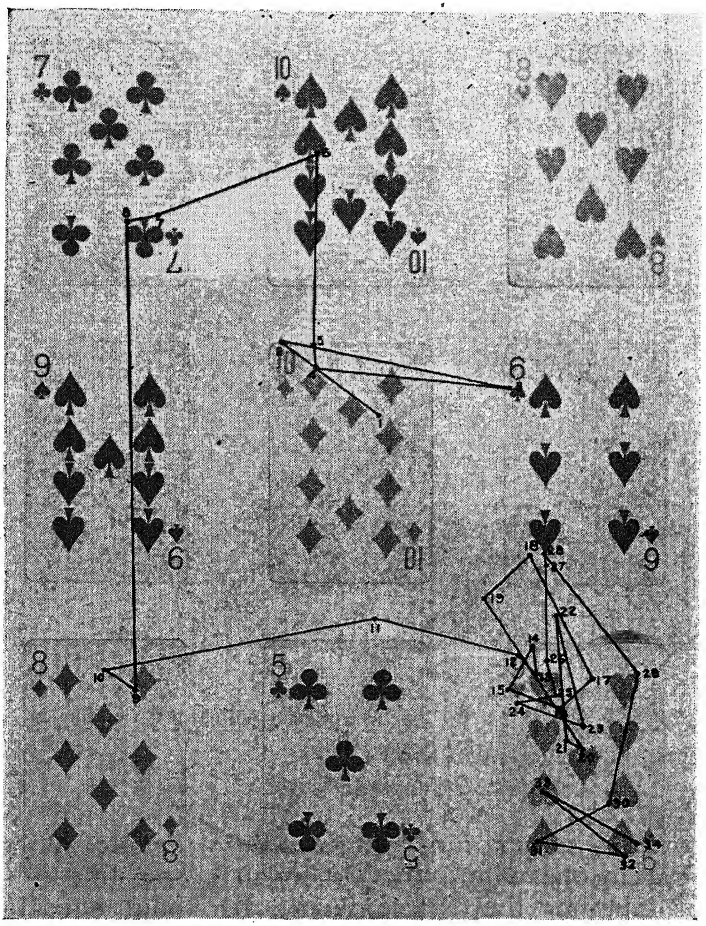


Fig. 86—Subject selects the nine of hearts for reproduction.

Another experiment was carried on by requesting fifteen subjects to look at advertisements of one kind or another among which was a group of pictures mounted on a card as show in Fig. 87. No instructions were given nor questions asked of the subjects as they looked at the group of pictures. Each subject read the statement in the center and then proceeded to look at the pictures of the students on the card.

Each subject knew only one of the men in the picture and the purpose of the test was to dis-

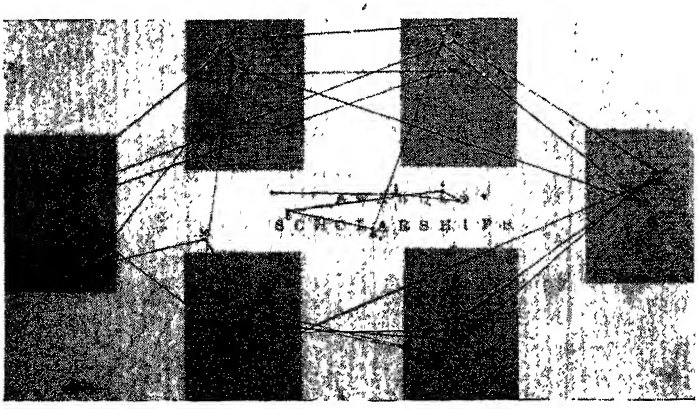


Fig. 87—Ocular pattern of subject responding to a familiar face.

cover whether individuals would devote more time to one whom they knew in a case like this or whether their time would be about equally divided. All but one of the subjects spent significantly more time with the student they knew than with any of the others in the group.

The writer believes that ocular photography might be employed in case a criminal will not speak and the Law desires to discover who his accomplice might be. It is likely that pictures of accomplices mounted with others on a card would receive more attention from the suspect than would pictures of individuals unknown to him. The forger of checks might also be identified by subjecting him to a test in which the forged check together with others would be presented for his observation.

TABLE XXXII

AVERAGE TIME SPENT BY STUDENTS ON PICTURES KNOWN OR UNKNOWN

Picture known to observer	4.19 sec.
Picture unknown observer	1.62
Reading material	2.72

Numerous other experiments related to this subject have been performed in the laboratories, and are in progress at the present time. Whether or not we can set the stage is our problem, but the writer is convinced that the eyes reveal many of the secrets of our innermost thoughts and desires.

Personality: Since personality traits such as introversion, aggressiveness, sociability, etc., are evaluated by analyzing the behavior of individuals, it is likely that the ocular performance will reveal certain of these characteristics. To verify this assumption a preliminary test was devised.

Thirty-two subjects, 16 men and 16 women, selected at random, were requested to observe the people and objects in Fig. 88 for a period of 15 seconds. The purpose of the test was to discover personality patterns of the two sexes.

Based on the data resulting from male and female subjects observing the twelve (12) areas as indicated in Fig. 88 the findings are as indicated in Table 33:

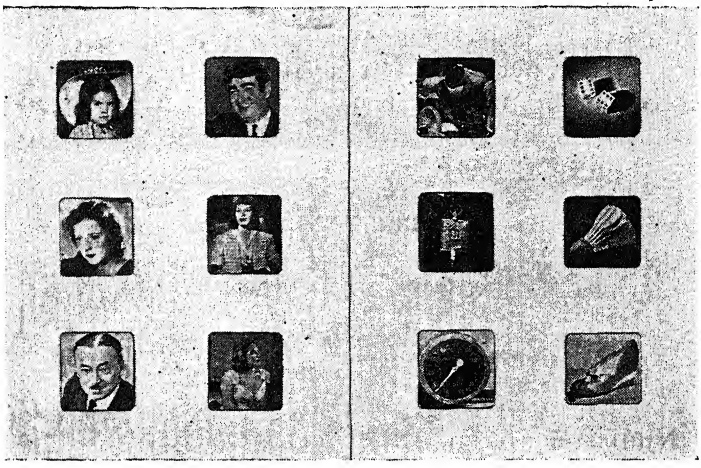


Fig. 88—Exposure cards observed by male and female subjects.

TABLE XXXIII

RELATIVE NUMBER OF TIMES SUBJECTS ENTERED OR REENTERED RESPECTIVE AREAS

Male			Female		
Times Entered Same Area	Total No. of Entries and Reentries		Times Entered Same Area	Total No. of Entries and Reentries	
0	18	0	0	30	0
1	58	58	1	81	81
2	73	146	2	51	102
3	32	96	3	16	48
4	8	32	4	9	36
5	1	5	5	2	10
6	1	6	6	1	6
7	0	0	7	7	7
	Total	343	Total		290

1. Male subjects make 343 entries and reentries into respective areas while female subjects make only 290 such entries.
2. Female subjects with a total of (290) entries fail to enter certain areas 30 times while male subjects out of 343 missed only 18.
3. Female subjects enter more areas once (81) times and remain longer than male subjects, who enter respective areas once only 58 times.
4. Male subjects reenter the same areas two and three times, or a total of 105 times, while female subjects reenter the second and third times in only 67 instances.
5. Generally speaking, female subjects reenter the respective areas less frequently than male subjects and as a result tarry longer in the same place.

TABLE XXXIV

RELATIVE DISTRIBUTION OF THE 343 ENTRIES AND REENTRIES OF MALE SUBJECTS INTO TWELVE (12) ARREAS

19	37	38	25
30	45	27	20
26	23	26	36

While it is generally conceded that individuals with introvertive traits have a tendency to be meticulous and pay close attention to details, while extroverts show quite an opposite inclination, it has been difficult to verify this assumption. First, because no adequate criterion has been established to evaluate the presence or absence of this trait, and secondly, because people often tend to show strong introvertive traits in one situation

and definite tendencies for extroversion in another.

Based on responses to tests, questionnaires, and practical situations, the concensus has generally been that women as a group are more introvertive than men and that the tendency is due to the influence of both nature and nurture.

TABLE XXXV

RELATIVE DISTRIBUTION OF THE 290 ENTRIES AND REENTRIES OF FEMALE SUBJECTS INTO THE TWELVE (12) AREAS

14	31	24	20
18	40	29	27
21	25	31	17

Whether we conclude that women are more introvertive than men on the basis of this study is not our problem. This may not even be an introversion trait.

TABLE XXXVI

Sex	Mean	SE	Mdiff	SEdiff	CR
Male	21.44	0.90			
			3.30	1.38	2.40
Female	18.33	1.04			

This sample may be too small to have predictive value, but from all indications, certain personality traits could be singled out by this technique. Greater differences on certain traits (a trait is a mode of conduct) may be found among members of the same sex than between the two sexes. It is even likely that by means of ocular photography certain abnormal personality traits could be detected and serve as a diagnosis preceeding clinical and psychiatric treatment.

Intoxication: Is the ocular performance of an intoxicated person different from that of those not so influenced? Is it likely that the degree of intoxication may be ascertained by the analysis of the ocular pattern of the intoxicated person? To be able to determine such a state has been significant in the courts when charging individuals with driving a car while intoxicated. Blood, urine, equilibrium tests, and others have been employed to ascertain the status of a person so affected. Tests to determine the adequacy of the assumption as above stated are now in progress.

Aptitude: If the relative function of peripheral and foveal vision is essential in effective and efficient adjustment in everyday living, it is altogether likely that the type of ocular performance employed by the individual is indicative of certain native aptitudes or capacities. It is likely that the ocular patterns of taxicab drivers, athletes, and salesman materially differ from those of scholars, mechanics, or artists. If this be so ocular performance properly analyzed may constitute a valid criterion for the selection of a vocation and training for an occupation properly adapted to the abilities of the individual.

Efficiency: With the ever increasing demands of the social order, manifested by the multiplication of books and periodicals, the profusion of advertisement in local and national publications, and the increasing number of fast moving vehicles and machines in industry, visual efficiency is becoming more and more essential. It is for such reasons that a scientific evaluation of how we see and how we should see is a major concern to everyone.

Photo-Electric Camera: In order that the individual can keep pace with the complicated and fast moving social and industrial order, it is imperative that Psychology utilize new and more highly developed mechanical devices. These new instruments of precision will yield new psychological concepts and units of measurements essential in obtaining the goal it has set for itself, namely, that of discovering the principles of human behavior.

Ocular photography, as one of these devices, is destined to have far reaching effects, mainly because it measures the most intricate of human adjustments and thus reveals certain psychological processes involved. With the photo-electric camera now in preparation, the elimination of sensitized film and laborious statistical computation should constitute a major advancement in the field of psychological instrumentation.

Only by employing instruments of precision and pooling our concepts based on such measurements, will we be able to project our thinking to establish Psychology as one of the major sciences, a place it rightfully desesves.

Picture vs copy: It is generally conceded that 80 percent of what we know has been achieved through the channels of vision. That is to say, in any learning situation the eyes play a major role and provide the major portion of our mental imagery.

The Chinese people have an adage that states that one picture is equal to 10,000 words. In modern lingo we would probably say that one picture is equal to four columns of print.

Regardless of how we express it, it still remains to be seen how even that much verbalization or print can produce a picture equal to one observed visually.

The mental picture of an individual is often very sketchy when based on the response to symbols of the printed page. To locate and maintain a scene in time and place without a physical layout is a difficult task and is at best only vague and fleeting. Imagine, for example, that you are directing a stranger to a place ten miles across the country. After you have given him necessary verbal directions and instructions of such landmarks as you deem essential he may still be bewildered until you get out a pencil and paper and sketch for him a diagram of the designated route.

Naturally, the language of the diagram is more easily organized in his mind and retained longer even if it is discarded immediately after some study. The directions can be more easily followed if the plan is clear. From a study of all the ocular patterns it is evident that relatively more time is spent on pictorial than on printed copy.

We are overdue in reprinting our public school text books in terms of a picture. A few explanations with a picture go far in making clear almost any issue and, in addition, aid the mind in recalling the main points of the story.

Talking book: It may be that we are not ready to provide what may be called a "talking book" but the demands are here to provide an illustrated book accompanied by sound which will relate the story while the reader looks at pictures.

This would provide, as in motion pictures, a simultaneous presentation of pictures and the story. Many possibilities lie in this field, it seems, if pictures in sequence can be produced. Scientific information as well as fiction could be presented by means of this technique.

Summary and conclusions: The reports in this volume are an attempt to present a scientific approach to the study of human behavior. The experiments reported on the pages of this book are an attempt to illustrate the possibilities of evaluating ocular performance and their psychological implications by means of photography.

It is the belief of the author that psychology will play a larger role in the study and control of the social order than it has in the past. Psychology, although only a baby among the sciences, is destined to make unprecedented progress due to the fact that it has at its disposal such highly developed sciences as physics, chemistry, biology, and engineering.

With all fairness to psychology and other sciences, the author does not wish to be presumptuous in making undue claims for Ocular Photography based up his findings. He therefore states many of these postulates and believes that by painstaking research these may be verified.

The development of the bidimensional camera and the findings as reported in this volume may add little to the advancement of scientific psychology, but to call attention to ocular photography as a scientific approach to the study of the human mind and behavior may have far reaching effects.

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GLOSSARY

ABILITY: Is considered to be the result of capacity plus training, measured by the difference in the initial and final practice.

ACCOMMODATION: The act of adjusting the lens of the eye to keep an image sharply focused on the retina. This is accomplished by changing the curvature of the lens in relation to the distance in which objects are to be seen.

ACUITY: Sharpness of vision or visual power; ability to distinguish sensory impressions in space or direction.

ADAPTATION: Any change in an organism, either in form or in function, which renders it better able to maintain its life in changed situations.

ADEQUATE STIMULUS: Is a type of stimulus which, under normal conditions, excites a sense organ. Light is considered adequate stimulus for the eye but not for the ear.

ADJUSTMENT: Any operation whereby an organism or organ becomes more favorably related to the environment or the situation.

AMBIGUOUS FIGURE: Is a picture in which certain parts may be interpreted in more than one way.

ANALYTICAL METHOD: That method of investigation which proceeds by breaking down compounds or intricate situations into more elementary units.

APPREHENSION: A low level of mental organization permitting understanding.

APTITUDE: A condition or set of characteristics regarded as symptomatic of an individual's ability to acquire with training some specified knowledge or skill.

GLOSSARY

AREA: An area as used in this study is a unit separated for purposes of analysis; Figs. 35, 36, 37, and 38 have areas, respectively.

ART: A generic term denoting production of any sort which appeals to the aesthetic feelings of man.

ARTISTIC APPRECIATION: The mental characteristics of passing discriminative judgment on works of art or of discovering the aesthetic qualities in the products of nature.

ASSOCIATION: The establishment of functional relations among psychological activities and states in the course of individual experience. Objects are associated with ideas and vice versa.

ASSOCIATION TIME: Is the interval of time elapsing between the giving of a stimulus and the associative response made by the subject.

ATTENTION: The clearest portion of a perceptual or ideational experience; a mental set, muscular posture, or mood which influences in a general way a person's behavior in a variety of situations.

BALANCE: Equality of opposing visual attraction or forces.

BLIND SPOT: A small area in the retina of the eye which is insensitive to light. It is the place where the optic nerve leaves the eyeball.

CENTRAL TENDENCY: Any typical or representative value of a given set of data generally expressed in mean, median, or mode.

COLOR: A property of visual sensation depending upon the effect of light of different wave lengths upon the retina and characterized by hue, tint, or saturation.

COMPLEMENTARY COLORS: Any two colors which, when mixed by a color wheel, approach the sensation of neutral gray.

CONDITIONED RESPONSE: A response which is set off by a stimulus (the conditioned stimulus) which originally was inadequate to initiate it.

CONSTANT: This is a term designating an advertisement or editorial which is placed on one page of a double spread while the material on the other page is altered. An advertiser may, for example, desire to know which of three layouts has the greatest attention value. The three advertisements are observed successively by individuals by placing them beside the constant.

CONTROL GROUP: A group of subjects used to make an experimental test to discover the effect by comparing it to another group in which a certain variable is operative. The two groups are alike in every respect except for one condition, which may be one of any number of things. Motivation may, for example, be tested by comparing one group not rewarded to one rewarded.

CONVERGENCE, VISUAL: The turning of the two eyes toward each other so that both eyes may fixate on the same object. Increased convergence is necessary as the distance between the individual and the object decreases.

CORNEA: The transparent part of the coat of the eyeball lying in front of the iris and the pupil.

CORRELATION: The tendency of certain paired measures to vary concomitantly so that knowledge of the value of one gives information as to the mean value of other measures paired with it.

CORRELATION COEFFICIENT: A symbol expressing the degree of relationship between two traits or measures.

CRITERION: A standard or model adopted for qualitative comparison. A basis for judgment of status.

CUE: A seemingly minor or secondary element in the stimulating situation which an individual utilizes as a guide to a response.

DEPTH PERCEPTION: Is direct appreciation of the distance of a given object or objects from the observer, or the relative distance from front to back in the perception of solid objects.

DISTRACTION: Withdrawal of attention from a given focus, either perceptual or imaginal, by irrelevant stimuli.

EFFECTOR: An organ which receives excitations from the nervous system and as a result of excitation, performs activity of some sort. The chief effectors are the muscles and the glands.

EFFICIENCY: Is the ratio of the energy output to the energy input.

ENVIRONMENT: A general term that includes all surrounding conditions, influences, or forces (physical, physiological, social) that act upon the organism.

EXCURSION: A term applied to an eye movement from one fixation point to another. Excursion Distance represents the space between subsequent fixation points.

EXERCISE: The frequent repetition of an act, usually for the purpose of acquiring skill or increasing proficiency in performance.

EXPERIENCE: The actual living through an event or a series of events.

EXTENSITY: A spatial characteristic or attribute of mental phenomenon.

FACILITATION: An increased ease in performance indicated by an improvement of speed, increased output, or greater smoothness of execution.

FATIGUE: A condition of the cells, induced by continued and excessive activity, resulting in the loss of power and efficiency.

FIXATION: The directing of the eye upon a point in space in such a manner that the image of the point falls upon the fovea.

FIXATION TIME: Is the duration of time a subject spends in any one area. He may make one or many fixations in an area, but the fixation time is the total time devoted to that area.

FOVEA: A small depression in the central region of the retina of the eye which is the place of clearest vision and the center of fixation.

GOLDEN MEAN: The golden mean is 1.00:1.68 ratio which is the geometric mean and also the constant factor in geometrical progression.

HABIT: A well learned pattern of activity that varies little from time to time, is easily elicited and so characterized by the facility of its performance.

ILLUMINATION: When an object receives radiant energy at wavelengths in the visible region it is illuminated. Illumination is measured in footcandles.

IMAGE: A picture or reproduction of an object produced by a lens, reflector, or optical system as a result of the focusing of light; or it may be an element of experience which is centrally aroused and which possesses all the attributes of the sensation.

INSIGHT: A depth of understanding or discrimination that involves an interpretation of given circumstances.

INTEGRATION: The formation of a whole from constituent parts.

INTELLIGENCE: The mental capacity of an individual to adapt to novel situations by improvising a novel adaptive response.
I. Q.: Is an abbreviation of the intelligence quotient of an individual and is the ratio of the mental age divided by the chronological age. A child with a mental age of ten and a chronological age of ten has an I. Q. of 100 (this is the average I. Q. of normal people)). A child with a mental age of eight and a chronological age of ten has an I. Q. of 80 (which is subnormal).

INTEREST: The excitment of feeling accompanying special attention to some object or scene.

INTROSPECTION: The examination of one's own feelings, sensations, efforts, ideas, and imagination.

INTROVERSION-EXTROVERSION: A measure of the extent to which an individual tends in his attitudes and behavior toward a reflective self-centered type or the energetic externally-minded type.

LEARNING: The improvement of efficiency of performance due to practice, usually measured by such standards as speed, freedom from error, better coordination, economy of effort, or perfection of form.

MACULA: A small, indefinite, pigmented area about two mm. in diameter, situated centrally in the human retina, within which area is the fovea centralis.

MOTIVE: A general term that includes all those driving forces which incite an individual to make a choice or to perform an act of some kind.

NON-PREFERRED POSITION: Has reference to a position in a given field that has been found, as a result of research, to be non-preferred by subjects. The non-preferred positions are the lower half, the right side, and the outside of a page.

NORM: An average obtained from giving tests to a large number of individuals in a certain trait or activity. It reveals a central tendency of a group on a given activity. This norm may be expressed in a mean, median, or mode.

OCULAR PATTERN: Is a reproduction of the eye movement record made by the subject while looking at a picture or an advertisement or when reading.

PERCEIVING: The interpretation of stimuli. The perception may vary in degree from simple to very complex. It is an awareness of the relation of objects, qualities, and their functions.

PERSONALITY: The integration of all the cognitive, conative, and physical characteristics of an individual as it manifests itself in focal distinction to others. The general characterization or pattern of an individual's total behavior.

PREFERRED POSITION: Has reference to a position in a given field that has been found, as a result of research, to be preferred by subjects. The preferred positions are the upper half, the left side, and the center of a page.

PROJECTOR: A device for controlling and directing light in a definite beam pattern.

PROTENSITY: A temporal characteristic or attribute of mental phenomenon.

PSEUDO-PSYCHOLOGY: Any system, doctrine, or exposition which purports to be psychology or to represent a psychological point of view, but which embodies or involves principles, postulates, or procedures that are in conflict with the best established principles of psychology.

PSYCHOLOGY: A scientific study of the behavior of individuals. (This may be conscious or unconscious behavior.)

READING SPAN: The number of words that can be repeated after a controlled time exposure of reading material.

RECEPTOR: The ending of an efferent neuron or specialized cell. Response, muscular contraction, glandular secretion, or any other activity of the organism which results from stimulation.

REFRACTION: The bending of light rays which occurs when leaving a medium of one density to enter a medium of some other density. In Illuminating Engineering, prisms are used to change the direction of light by refraction.

REGRESSION: A right to left return of one or both of the eyes during reading.

REGRESSION FREQUENCY: Number of times the eyes tend to retrace or review portions of the line being read.

RETINA: The innermost of the three coats of the eyeball. Here essential nerve endings are located which respond to light and color. The rods are sensitive to light while the cones are sensitive to both light and color.

SACCADIC MOVEMENT: A movement of the eyes from one fixation point to another.

SENSATION: A first conscious response to a stimulus, such as awareness of something being present.

SPLIT-RUN TEST: Several different advertisements for one product, the same size, same position, same day, and next to the same editorial, are run in the same medium. The advertisement may be changed in one respect in one-half or one-third of the circulation with coupon keyed to identify the responce. The returns measure the difference between the effectiveness of the several advertisements.

GLOSSARY

STATISTICAL FORMULAE:

ΣX — Sigma large — all possible value of x are summed.

$M = \frac{\Sigma X}{N}$ — Arithmetic mean calculated from raw scores.

$M_d = M_1 - M_2$ — Mean difference of two distinctions.

$\sigma = \sqrt{\frac{\Sigma x^2}{N}}$ — Standard deviation — dispersion calculated from the mean (ungrouped data).

$\sigma = \frac{\sigma}{\sqrt{N-1}}$ — Standard error of the mean.

$\sigma_d = \sqrt{\frac{\sigma_1^2}{N_1} + \frac{\sigma_2^2}{N_2}}$ — Standard error of the difference between the two means.

$C.R. = \frac{M_d}{\sigma_d}$ — Critical Ratio — the ratio of the mean difference and the standard error of the difference. If the difference between m^1 and m^2 is three times greater than the difference of the standard error between the two means, chances are 99.9 that the difference is due to variables other than chance.

CRITICAL RATIO

C. R.	Chances in 100 that difference is real
.5	69
1.0	84
1.5	93
2.0	98
2.5	99.4
3.0	99.9

If the critical ratio (C.R.) is 3.0, the chances of its being reversed on a repetition of the experiment or tabulations are only 1 in 1000. A critical ratio of 3.0 is accepted by most scientist as indicating a real or significant difference. The reliability, however, depends upon the N of raw scores which is increased by the square of the number of scores added to the distribution.

STATISTICALLY SIGNIFICANT: Is a term used to indicate that the difference between two groups was due to some independent variable and not to chance. To be statistically significant, the difference between two means of a distribution should be three times greater than the standard error of the two means.

STIMULUS: An energy external to a receptor which excites the receptor.

TACHISTOSCOPE: An instrument for the presentation of visual stimuli such as a picture, a word, or a group of symbols for a short and predetermined period of time.

TRAIT: Psychologically, a mode of conduct arising from an individual's native endowments as modified by his experience.

VARIABLES, DEPENDENT AND INDEPENDENT: When two or more variables are interrelated, as indicated by an algebraic equation, and values are assigned to all the variables except one, that one is called the dependent variable; the other variable or variables, the independent variables.

VISIBILITY: The ability to be seen or to facilitate seeing; the distinctness with which objects may be observed.

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